

The sand and gravel resources of the country north-east of Ripon, North Yorkshire

Description of 1:25 000 sheet SE 37 and part of 47

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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 sub-series. Reports numbered 13 to 139 appeared as Mineral Assessment Reports of the Institute; subsequent reports appear as Mineral Assessment Reports of the British Geological Survey.

Details of published reports are given at the end of this report.

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PREFACE

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

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

This report describes the sand and gravel resources of 150 km² of country north-east of Ripon, North Yorkshire, shown on the accompanying resource map. The survey was conducted by A. N. Morigi, D. Thomas, J. R. A. Giles and I. Jackson. The work is based on a six-inch geological survey by A. C. Benfield, A. H. Cooper, C. G. Godwin, H. Johnson and J. H. Powell in 1977-78 and 1980-82. A. C. Benfield and A. H. Cooper have supplied information for the account of the geology of the district. B. Cannell, assisted in the field by A. N. Morigi, conducted a geophysical, shallow resistivity, survey at some localities, as a supplement to the drilling programme.

J. D. Burnell, ISO and G. I. Coleman (Land Agents) were responsible for negotiating access to land for drilling. The ready co-operation of landowners and tenants and of Ure Aggregates Ltd and Ripon City Gravel Co Ltd is gratefully acknowledged.

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The sand and gravel resources of the country north-east of Ripon, North Yorkshire in pocket			

The sand and gravel resources of the country north-east of Ripon, North Yorkshire

Description of 1:25 000 sheet SE 37 and part of 47

A. N. Morigi and J. W. C. James

SUMMARY

The geological maps of the British Geological Survey, pre-existing borehole information, 12 resistivity soundings and 117 boreholes drilled for the Industrial Minerals Assessment Unit form the basis of the assessment of the sand and gravel resources of the country north-east of Ripon, North Yorkshire.

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

The 1:25 000 map is divided into five resource blocks, containing between 3.9 and 21 km² of sand and gravel. For each block the geology of the deposits is described, and the mineral-bearing area, the mean thickness of overburden and mineral and the mean gradings are stated. Detailed borehole data are also given. The geology, the position of the boreholes and the outlines of the resource blocks are shown on the accompanying map.

Notes

Each registered borehole is identified by a four-element code (e.g. SE 37 NW 34). The first two elements define the 10-km square (of the National Grid) in which the borehole is situated; the third element defines a quadrant of that square, and the fourth is the accession number of the borehole. In the text of the report the borehole is normally referred to by the last three elements alone (e.g. 37 NW 34).

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

Bibliographical reference

MORIGI, A. N. and JAMES, J. W. C. 1984. The sand and gravel resources of the country north-east of Ripon, North Yorkshire: description of 1:25 000 resource sheet SE 37 and part of SE 47. *Miner. Assess. Rep. Brit. Geol. Surv.*, No. 143.

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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, neither the economic nor the social factors used to decide whether a deposit may be workable in the future can be predicted; they are likely to change with time. Deposits not currently economically workable may be exploited as demand increases, as higher-grade or alternative materials become scarce, or as improved processing techniques are applied to them. The improved knowledge of the main physical properties of the resource and their variability, which this survey seeks to provide, will add significantly to the factual background against which planning policies can be decided (Archer, 1969; Thurrell, 1971, 1981; Harris and others, 1974).

The survey provides information at the 'indicated' and 'inferred' levels. 'Indicated' assessments "are computed partly from specific measurements, samples or production data and partly from projection for a reasonable distance on geologic evidence. The sites available for inspection, measurement, and sampling are too widely or otherwise inappropriately spaced to permit the mineral bodies to be outlined completely or the grade established throughout". 'Inferred' assessments are those "based largely on broad knowledge of the geologic character of the deposit and for which there are few, if any, samples or measurements." (Bureau of Mines and Geological Survey, 1948, p. 15).

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

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

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

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

For the particular needs of assessing sand and gravel resources, a grain-size classification based on the geometric scale $\frac{1}{16}$ mm, $\frac{1}{4}$ mm, 1 mm, 4 mm, 16 mm, 64 mm has been adopted. The boundaries between fines (that is,

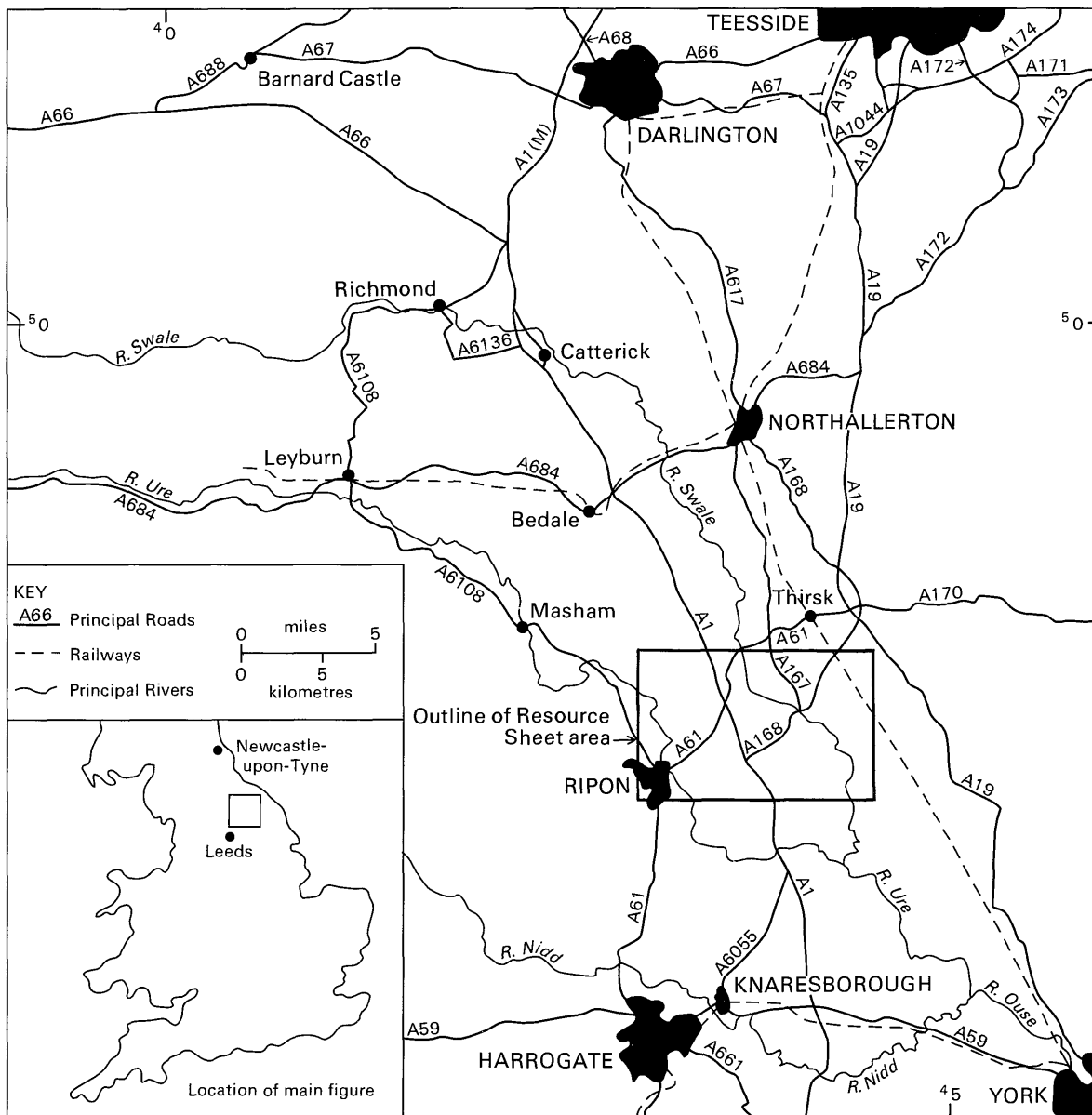


Figure 1 Sketch map showing the location of the district

the clay and silt fractions) and sand, and between sand and gravel material, are placed at $\frac{1}{8}$ mm and 4 mm respectively (see Appendix C).

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

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

DESCRIPTION OF THE DISTRICT

General

The district occupies 150 km² of country in the county of North Yorkshire (Figure 1). The largest settlement is the city of Ripon in the south-west of the district

(Figure 2). Minor light industry, notably varnish and paint manufacture, is confined to Ripon and its environs; elsewhere argiculture is the main activity. Arable farming is predominant, particularly cereal and root cropping, with some stock rearing. Locally, intensive poultry rearing supports a poultry packing and processing factory at Dalton [433 763]. Two Ministry of Defence airfields are located within the area at Dishforth [382 715] and near Topcliffe [401 783]. The River Ure flows southwards near the western boundary of the district, and the River Swale south-eastwards from Skipton-on-Swale [366 798] to Brafferton [438 701]. The average elevation of the floodplain of the Ure is approximately 20 m AOD and that of the Swale slightly lower at about 15 m AOD. Between the valleys of these rivers, the ground rises to a maximum height of 75 m AOD northeast of Copt Hewick [340 713]. From here the ground slopes away gently to the north, but to the south it is undulating. A broad ridge sub-parallel to the River Swale between Skipton-on-Swale and Brafferton, which is breached twice by the Swale, has a series of summits (e.g. at Cundall [424 726], Asenby [398 753] and south-east of Skipton-on-Swale) with an elevation of approximately 30 m AOD. East of this ridge, the terrain is generally flat with an average elevation of 20 to 25 m AOD.

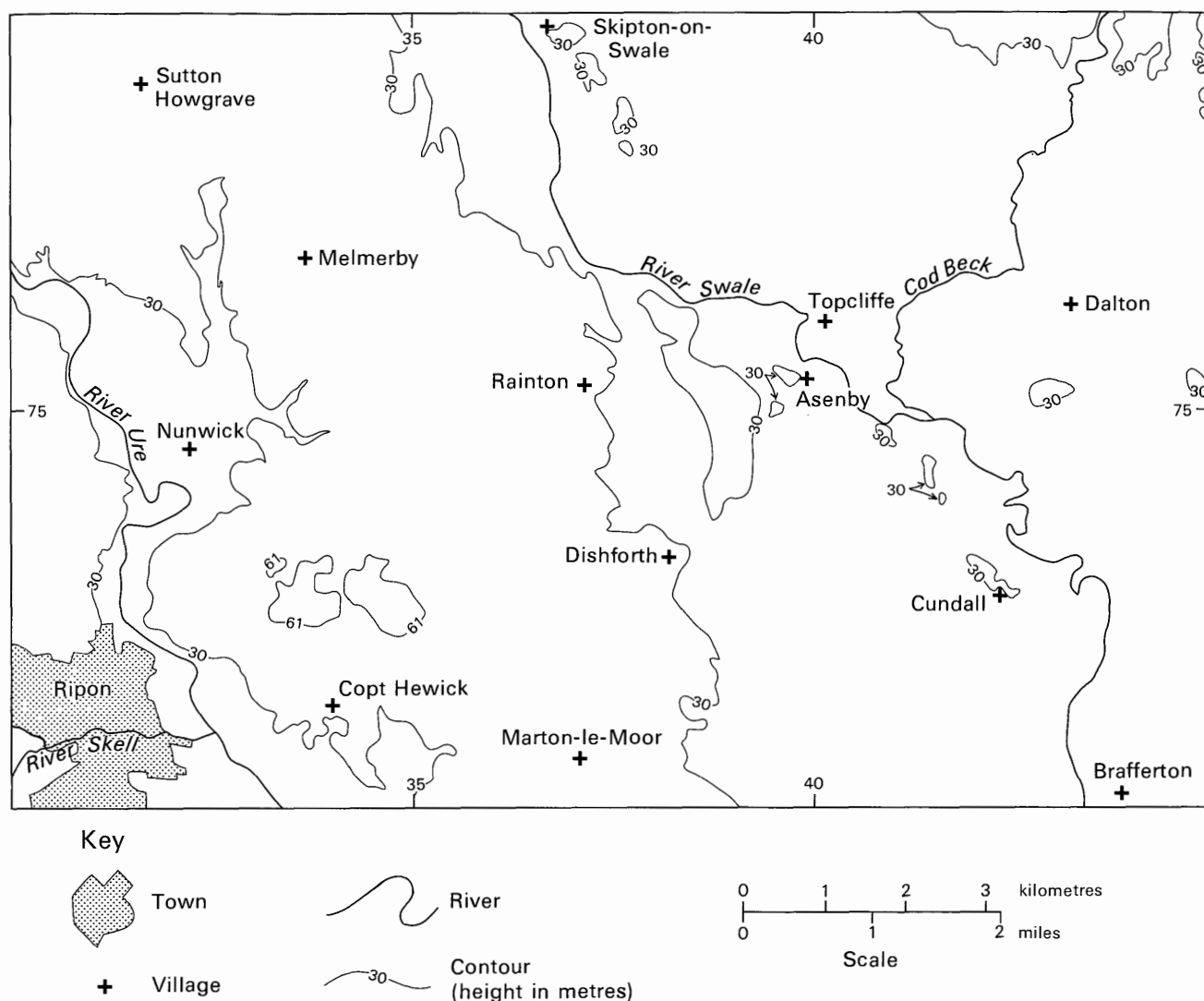


Figure 2 Locality map

Geology

The drift deposits of the district and the 'solid' formations that crop out beneath them and are rarely seen at the surface, are listed in Table 1 and described briefly below. Further details may be found in IGS Open File Reports on 'The geology of the country around Dalton, North Yorkshire' (Benfield, 1983), and 'The geology of the country north and east of Ripon, North Yorkshire' (Cooper, 1983), upon which the following account is partly based.

SOLID

The solid geology is undivided on the accompanying resource sheet, because in the east of the area it is still under investigation by the Field Staff of the Survey. A sketch map (Figure 3) illustrates the information presently available; the three youngest groups are undivided, and the westward extension of the Coxwold-Gilling fault structure (Fox-Strangways and others, 1886) is represented in part by an east to west trending 'zone of disturbance'. This structure does not appear to pass westwards beyond the outcrop of the Sherwood Sandstone Group rocks. There are no extensive outcrops of solid strata, and those that are present are confined mainly to the south-western quarter of the district, around Catton [370 780] in the north, and to the valley sides of the Swale and the Ure. Almost 80 per cent of the boreholes drilled by IMAU across the district

terminated in the solid before the 18 or 25 metres arbitrary maximum depth limits for the survey were reached (see arbitrary physical criteria, p. 1).

Permian rocks are confined to the western margin of the district. The oldest of these, generally cropping beneath drift, is the Lower Magnesian Limestone, which consists of dolomite, dolomitic limestone and some beds of mudstone. Above is the Middle Marl, reddish brown calcareous mudstones with, mainly at depth, beds of anhydrite and gypsum. The dissolution of these evaporites by percolating groundwater has caused the local collapse of the overlying strata.

The Upper Magnesian Limestone, comprising thinly bedded dolomitic limestone, is overlain by Upper Marl, which consists of reddish brown silty calcareous mudstone with gypsum and anhydrite at depth. In its upper part, thin sandstones are present as the Upper Marl passes upwards into the Triassic Sherwood Sandstone Group, a soft, reddish brown micaceous sandstone with an extensive outcrop, mainly beneath drift, across the central part of the district.

The overlying Mercia Mudstone Group consists mainly of reddish brown mudstone with sporadic thin beds of greyish green siltstone and sandstone, and, especially in its upper part, nodular, disseminated and fibrous gypsum. The Mercia Mudstone is succeeded by the Penarth Group which comprises dark grey and black mudstone and siltstone with thin pyritic sandstone beds, overlain by

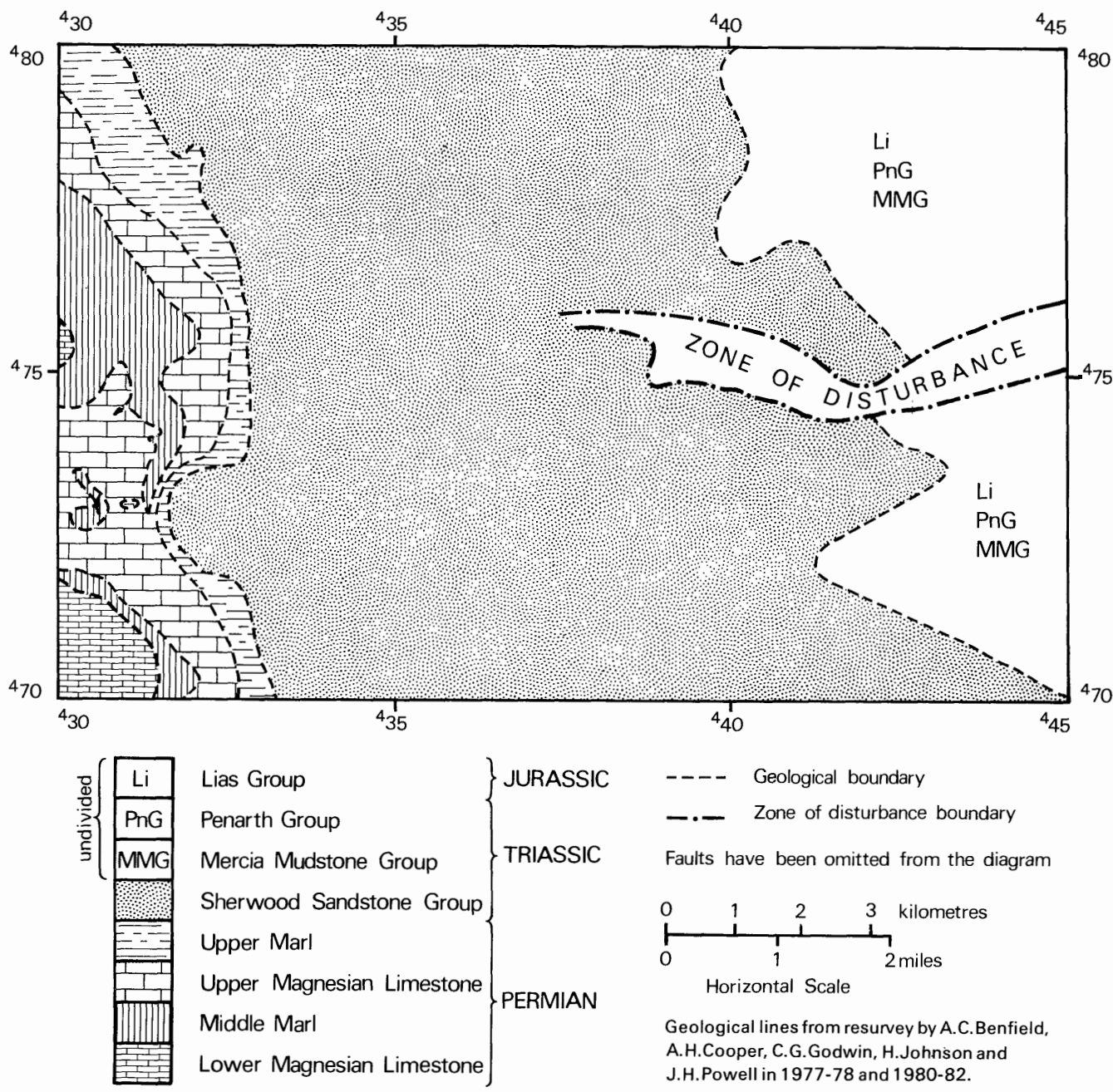


Figure 3 Sketch map showing the solid geology of the district

greenish grey mudstone with thin beds of siltstone. The Penarth Group represents a marine transgression, and marine conditions are continued with the Lias Group. These strata are mainly grey mudstones and siltstones with subordinate beds of limestone, calcareous and ferruginous sandstone, sideritic and chamositic ironstone.

DRIFT

Glacial deposits are the primary constituent of the drift and most, if not all, of these are the product of the last, or Devensian, glaciation. The river terrace deposits, blown sand, alluvium and peat are of post-glacial origin. The composition of those drift deposits that are comprised almost wholly of sand and gravel is more fully described under 'Composition of the Sand and Gravel Deposits' (below).

Sand and gravel of unknown age (in buried valleys) Two buried valleys have been identified within the district (Benfield, 1983; Cooper, 1983). One underlies the valley

of the River Ure, and the other runs sub-parallel to the Swale from near Topcliffe Airfield, passing east of Cundall, to Brafferton.

The basal sands and gravels within these buried valleys are classified as sand and gravel of unknown age. They may be found beneath till, as for example in IMAU borehole 37 NW 47, or beneath alluvium, river terrace deposits, fluvio-glacial sand and gravel or glacial sand and gravel. Where these last four deposits consist of sand and gravel and lie directly on sand and gravel of unknown age, the junction is difficult to define, as for example, in IMAU borehole 37 SW 106, which contains at least 21.4 m of gravel. Within this borehole and in 37 SW 103, some horizons of gravel are cemented with calcareous tufa, deposited by calcium-rich waters flowing from the adjacent Permian limestone and gypsum bedrock.

Sand and gravel of unknown age does not everywhere consist wholly of sand and gravel: for example, in IMAU borehole 37 NW 45, at least 4.5 m of sandy silt and laminated clay were noted at the base of the deposit. In IMAU borehole 37 NW 55 the deposits within the buried

Table 1 Geological sequence.

DRIFT	
Quaternary	Peat
	Alluvium
	River Terrace Deposits, undifferentiated
	Blown Sand
	Sand) Glacial Lake Deposits
	Silt and Clay) (including penecon-temporaneous fluviatile deposits)
	Fluvio-glacial Terrace Deposits, undifferentiated
	Fluvio-glacial Sand and Gravel
	Laminated Clay closely associated with Glacial Deposits
	Glacial Sand and Gravel
	Sandy Till
	Till
	Sand and Gravel of unknown age (in buried valleys)
SOLID	
Jurassic	Lias Group
Triassic	Penarth Group
	Mercia Mudstone Group
	Sherwood Sandstone Group
Permian	Upper Marl
	Upper Magnesian Limestone
	Middle Marl
	Lower Magnesian Limestone

valley comprise 7.8 m of laminated clay, resting on at least 2.0 m of till. A thick development of these deposits is probably present in borehole 37 NE 53 at Rush House [3917 7964], where 6.1 m of glacial lake deposits overlie 33.2 m of sand, resting on bedrock. The sand sequence is interpreted as glacial sand and gravel resting on sand and gravel of unknown age.

Till and Sandy till These deposits, at outcrop, cover much of the district between the rivers Swale and Ure, and also west of the Ure. Elsewhere, beneath younger drift deposits, they overlie bedrock.

The till comprises a silty, sometimes sandy, stony clay, generally moderate brown (5 YR 3/4 -4/4) in colour (Geological Society of America, Rock-Color Chart Committee, 1975), although this becomes greyish red (5 R 4/2) in the east of the district. It is firm to hard, rarely very hard, as measured in the field using a pocket penetrometer.

Erratics within the till are generally rounded, coarse to fine pebbles and some cobbles, predominantly of Carboniferous sandstone and limestone. In the east of the district, some Triassic sandstone and mudstone and Jurassic sandstone and limestone clasts are included and in the west on the Permian crop, locally derived limestone is apparent near the base of the till. Rare farther-travelled erratics, including Palaeozoic volcanics, sandstones and limestones from the Lake District, north-east England and southern Scotland, may also be found.

The sandy till is generally a moderate reddish brown (10 R 4/6) sandy clay, in places very sandy. It is too soft for its hardness to be accurately measured by the pocket penetrometer. It commonly overlies Sherwood Sandstone and is also associated with glacial sand and gravel. Within sandy till, erratics are not abundant, although where present they are mostly of Carboniferous origin. However, subangular Sherwood Sandstone clasts are common at the base of sandy tills overlying this group.

The maximum proven thickness of till in the district is at least 19.6 m (the base was not reached), recorded in IMAU borehole 37 SW 109, but both till and sandy till may include beds of sand, gravel and silt.

Glacial sand and gravel The major outcrops of glacial sand and gravel are confined to an esker trending from north-west to south-east as an undulating ridge from Skipton-on-Swale through Asenby to Brafferton. There are also small scattered outcrops in the west of the district.

The deposits of glacial sand and gravel within the esker are of two broad types. In the northern half of the esker, above Asenby, they generally comprise 'clayey' or 'very clayey', fine, quartz sand, whereas in its southern half, fine and coarse gravel with some cobbles becomes the predominant constituent, although sand and 'clayey' sand are present.

Within IMAU boreholes, 24.5 m is the maximum recorded thickness for glacial sand and gravel (37 NE 35), but this includes three horizons of clay totalling 2.2 m. Elsewhere lenses, partings and beds up to 3.2 m thick of till, silt and clay have been noted within the glacial sand and gravel. Similar deposits, up to 9.3 m thick, have been recorded overlying glacial sand and gravel, not only within the esker, but also in the north-west of the district around Sutton Howgrave [315 794] and Middleton Quernhow [334 785], where there is evidence of a relatively extensive deposit of glacial sand and gravel at depth. The relationship between glacial sand and gravel and the other glacial deposits is complex, both vertically and laterally.

Laminated clay closely associated with glacial deposits

These deposits are developed within the esker complex. They are generally recorded at depth interbedded with glacial sand and gravel while at outcrop they are restricted to small occurrences west of Brafferton and between Cundall and Asenby. An IMAU borehole, 47 SW 35, in the former outcrop proved 6.7 m of the deposit, but elsewhere, at depth, it is generally less than 2 m in thickness.

The deposit consists mainly of dark yellowish brown (10 YR 4/2) to greyish brown (5 YR 3/2) laminated clay, with laminae of fine sand and silt. It is soft to firm and only rarely includes fine pebbles of Carboniferous and Triassic origin.

Fluvio-glacial sand and gravel Small outcrops of fluvio-glacial sand and gravel occur within and adjacent to the valley of Holme Beck [330 790] in the north-west of the district. IMAU borehole evidence (37 NW 38) suggests that fluvio-glacial sand and gravel underlies some of the alluvium in the valley floor. The deposit comprises pebbly sand with few boulders, and fine to coarse gravel, consisting of Carboniferous sandstone and limestone with subordinate Magnesian Limestone and Sherwood Sandstone pebbles.

Fluvio-glacial terrace deposits, undifferentiated The most extensive outcrops of these deposits occur in the relatively narrow valleys of Norton Beck [310 776] and Upland Stell [312 785], which run parallel to the Ure Valley in the north-west of the district. The other major occurrences are within the valleys of the rivers Skell and Laver at Ripon. Elsewhere along the Ure, only small remnants remain of a once extensive outcrop.

The deposit varies from coarse gravel to pebbly sand and includes thin beds of sand. Carboniferous sandstone and limestone are the commonest rock types, but Permian limestones are an additional constituent, mainly in the south-west of the district. The deposit varies in recorded thickness from 0.8 m to more than 7.0 m near Ripon. Not only may the deposit be less than a metre thick (IMAU borehole 37 NW 34) but also, in the north-west of the district, it may consist of very sandy stony clay, as in IMAU borehole 37 NW 46.

Glacial lake deposits (including penecontemporaneous fluvial deposits) These deposits have been divided into two lithological categories: silt and clay, and sand. Both are largely confined to the east of the district where, together, their numerous outcrops form an extensive spread of glacial lake deposits.

Silt and clay is the dominant lithology and generally comprises dark yellowish brown (10 YR 4/2) to greyish brown (5 YR 3/2) soft to firm laminated clay, finely laminated with silt and sand, and containing also some thin beds of sand and silt. The deposits are relatively thick, with a maximum recorded thickness of 21.0 m in IMAU borehole 47 SW 33.

The sand generally overlies silt and clay, and consists of fine to medium 'clayey' or 'very clayey' sand. It varies in recorded thickness from less than a metre to 2.8 m in IMAU borehole 47 NW 58; the upper 1.7 m of the deposit in this borehole comprises fine gravel and is believed to be a penecontemporaneous fluvial deposit resting on glacial lake deposits. Exceptionally, in IMAU borehole 47 SW 18, the sand consists of two horizons totalling 6.5 m interbedded with 1.9 m of laminated clay.

Blown Sand Three small spreads of blown sand occur on the sandy till and till outcrops between Rainton [370 752] and Marton-le-Moor [372 705]; they consist of silty fine sand.

River terrace deposits, undifferentiated Along the Ure, the largest spread of river terrace deposits extends north-westwards from Nunwick [322 744]; downstream, the valley narrows and only small areas of the deposit are present. Relatively extensive outcrops occur within the valleys of the Laver and Skell at Ripon. River terrace deposits in the Swale valley are confined to a single small outcrop of clayey sand at Brafferton.

Within the Ure valley, the deposit is generally a gravel of Carboniferous limestone and sandstone clasts, similar in composition to the fluvio-glacial terrace deposits. It varies in recorded thickness from 1.8 to 7.0 m, but where it lies directly on sand and gravel of unknown age, up to 12.0 m of gravel have been noted for the combined deposit. In some localities the terrace gravels are overlain by up to 2.2 m of clay and silt.

Alluvium Relatively extensive alluvial deposits are confined to the Ure valley and the valley of the Swale downstream from Topcliffe. Their tributary valleys commonly contain narrow outcrops adjacent to their streams. Elsewhere, alluvium infills small hollows, mainly on the till and sandy till outcrops.

Within the Ure valley, the deposit is generally a gravel, although beds of 'clayey' and 'very clayey' sand also occur. It varies in recorded thickness from 3.9 to 10.5 m, although in some localities gravel may exceed this maximum where alluvium rests directly on and cannot be differentiated from sand and gravel of unknown age. Locally, the gravels and sands may be overlain by up to 2.0 m of silt and clay.

The alluvial deposits of the Swale appear to be sandier in nature: up to 7.2 m of 'very clayey' sand have been recorded (IMAU borehole 47 SW 36), but gravel is present in some localities. Interbedded clays and silts, up to 2.3 m thick, occur within the sands and gravels which are commonly overlain by similar clays and silts up to 5 m thick.

Peat Peat fills hollows within the esker near Asenby and elsewhere on the till and sandy till outcrop. It is also closely associated with alluvium in some of the river valleys.

Composition of the Sand and Gravel Deposits

Potentially workable deposits are found within sand and gravel of unknown age, glacial sand and gravel, fluvio-

glacial sand and gravel, fluvio-glacial terrace deposits, sand of glacial lake deposits, river terrace deposits and alluvium. Locally (for example in borehole 37 NW 49, near Melmerby), sandy till may grade as mineral, but it is generally thin and variable in thickness; it is unattractive as a possible resource because of the high percentage of fines and the fine-grained nature of the sand, and has therefore been excluded from the assessment.

Detailed grading data and a description of the sand and gravel deposits based on visual inspection are included in the borehole logs in Appendix E. The results of a number of detailed pebble analyses from selected boreholes and deposits are given in Table 2. The results of mechanical tests carried out according to BS 812 (British Standards Institution, 1975) upon aggregates from several boreholes are shown in Table 3.

Sand and gravel of unknown age Mineral within this deposit has a mean grading of 7 per cent fines, 45 per cent sand and 48 per cent gravel. Borehole 37 SW 103 encountered pebbly sand and 'clayey' pebbly sand overlying gravel, whereas borehole 37 NW 45 proved 'clayey' sand. A pre-existing borehole, 37 NE 53, recorded a considerable thickness of sand, but detailed grading data are not available.

The gravel fraction is commonly composed of roughly equal proportions of fine and coarse pebbles with some cobbles. Carboniferous limestone and sandstone predominate, but small amounts of Magnesian Limestone, chert and Triassic sandstone are also present. In boreholes 37 SW 103 and 106, the gravel is cemented, in part, with calcareous tufa. The sand fraction is mainly medium-grained, subangular to subrounded quartz, with some lithic grains in the coarser grades.

Glacial sand and gravel These sediments contain the major sand and gravel resources of the district. Within these complex deposits, rapid lateral and vertical variations in grade were found, including clay and very sandy clay as well as sand and gravel. Mineral within the deposit has a mean grading of 12 per cent fines, 62 per cent sand and 26 per cent gravel ('clayey' sandy gravel), and ranges in composition from 'very clayey' sand and 'clayey' sand, through sand, 'clayey' pebbly sand, 'very clayey' pebbly sand and sandy gravel to gravel. Between Skipton-on-Swale [366 798] and Topcliffe [400 760] mineral is predominantly 'clayey' and 'very clayey' sand, comprising fine-grained, subangular to rounded quartz with subordinate lithic grains. Elsewhere gravel is the most frequently encountered deposit. The gravel fraction is fine and coarse with some cobbles, and comprises subrounded to well-rounded Carboniferous limestone and sandstone with small amounts of angular to rounded chert, Triassic sandstone and mudstone, Palaeozoic mudstone, igneous rocks and traces of ironstone and quartz; exceptionally, borehole 37 SE 42 contained a considerable percentage of Triassic mudstone and siltstone. Sand within the gravel deposits is commonly fine to medium-grained, with some coarse, subangular to subrounded quartz, and subordinate lithic grains of similar composition to the gravel.

Fluvio-glacial sand and gravel Mineral within this deposit proved to be thin and of limited extent. Borehole 37 NW 38 encountered gravel with a grading of 6 per cent fines, 23 per cent sand and 71 per cent gravel. The fine and coarse gravel consists of Carboniferous limestone and sandstone in similar quantities, together with small amounts of Magnesian Limestone, chert, ironstone, Triassic sandstone and igneous rocks. Sand within the deposit comprises fine to coarse subrounded lithic grains.

Fluvio-glacial terrace deposits These deposits occur in two areas. In the north-west, the mineral comprises generally thin and discontinuous gravel, with the exception of that in borehole 37 NW 52, which encountered

Table 2 Lithological analyses of the +8 -16 mm gravel from selected boreholes (expressed in percentage weight).

Borehole	Depth in metres	Limestone		Chert	Sandstone		Mudstone/Siltstone			Ironstone	Quartz	Igneous	Calcareous tufa	Others
		Carbon-iferous	Magnesian		Carbon-iferous	Triassic	Permian	Triassic	Palaeozoic					
Alluvium														
37 NE 33	4.3-6.5	69	-	1	29	1	-	-	-	-	trace	-	-	trace
37 SW 103	0.5-1.5	51	-	1	41	1	-	-	2	-	trace	1	-	3
	7.5-8.5	42	1	6	48	trace	-	-	-	-	-	-	-	3
River Terrace Deposits														
37 NW 56	0.5-1.2	51	-	3	45	trace	-	-	trace	trace	-	-	-	1
	3.2-4.7	71	-	1	26	-	trace	-	-	-	-	-	-	2
Fluvio-glacial Deposits														
37 NW 38	3.1-4.1	47	2	2	39	1	-	-	-	2	-	1	-	6
37 NW 52	1.5-2.5	67	-	4	29	-	-	-	-	-	-	trace	-	trace
37 SW E1*	0.0-3.0	31	42	1	26	-	-	-	-	trace	-	-	-	-
	4.0-5.5	32	37	4	27	-	-	-	-	-	-	-	-	-
	6.0-7.0	39	34	1	26	-	-	-	-	trace	-	-	-	trace
Glacial Lake Deposits														
47 NW 58	2.1-3.1	43	trace	4	36	2	-	6	4	-	trace	-	-	5
Glacial Sand and Gravel														
37 NE 51	8.0-10.0	30	-	1	61	1	-	trace	-	-	-	1	-	6
	12.0-13.4	36	-	trace	54	6	-	-	-	-	trace	1	-	3
37 SE 42	0.4-2.8	9	-	2	81	1	-	trace	3	-	1	1	-	2
	3.2-5.8	37	-	1	45	2	-	12	-	trace	-	-	-	3
	5.8-6.8	20	-	-	35	1	-	42	-	-	-	-	-	2
47 SW 16	2.6-3.3	40	-	3	47	-	-	4	-	trace	trace	2	-	4
	5.2-8.2	31	-	-	53	1	-	9	3	-	-	2	-	1
47 SW 32	4.6-5.8	-	-	1	91	-	-	-	-	-	1	-	-	7
	14.2-15.2	47	-	-	46	trace	-	trace	3	-	trace	2	-	2
47 SW 36	7.5-8.5	17	-	7	50	2	-	3	5	-	2	trace	-	14
	15.0-16.0	35	1	1	56	1	-	3	-	-	-	1	-	2
Sand and Gravel of unknown age														
37 SW 103	21.5-22.5	56	3	1	25	trace	-	-	-	-	-	-	8	7

*Exposure

Table 3 Mechanical properties of aggregate from representative boreholes

Borehole	Aggregate Impact Value	Aggregate Crushing Value
Alluvium		
37 NE 33	21	
River Terrace Deposits		
37 NW 56	22	
Fluvio-glacial Terrace Deposits		
37 NW 52	22	
Fluvio-glacial Sand and Gravel		
37 NW 38	29	
Sand of Glacial Lake Deposits		
47 NW 58	27	
Glacial Sand and Gravel		
37 NE 51	28	
37 SE 42	29	23
47 SW 16	29	21
47 SW 32	29	
47 SW 27	27	
Sand and Gravel of unknown age		
37 SW 103	25	20

4.9 m of pebbly sand. The fine and coarse gravel chiefly comprises Carboniferous limestone with Carboniferous sandstone and some Magnesian Limestone. Sand within the deposit consists of fine to coarse, subangular to sub-rounded quartz with some lithic grains. Around Ripon, in the southwest of the district, mineral within these deposits is significantly thicker (e.g. 7.0 m in exposure 37 SW E1). It grades as coarse gravel, although borehole 37 SW 111 encountered 'very clayey' gravel, and an exposure in Atkinson's Quarry (37 SW E1) revealed subordinate deposits of cross-bedded, medium-grained sand. Here, subrounded to well-rounded Magnesian Limestone, Carboniferous limestone and sandstone are the main constituents of the gravel, with some chert and traces of ironstone. The sand fraction comprises medium-grained subrounded quartz with lithic grains. The overall mean grading of the mineral is 7 per cent fines, 46 per cent sand and 47 per cent gravel.

Sand of glacial lake deposits (including penecontemporaneous fluvial deposits) While these deposits are widespread, particularly in the east of the district, mineral within them is thin and discontinuous. A small area in the northeast is considered to include potentially workable deposits, but elsewhere, for example around borehole 47 NW 72, sand and gravel is restricted to too small an area to be included in the assessment, except where it overlies mineral within other deposits (e.g. as in resource blocks C and D).

The mean grading of all samples is 20 per cent fines, 71 per cent sand and 9 per cent gravel ('very clayey' pebbly sand). There is, however, considerable variation in grading from 'clayey' sand in boreholes 47 NW 57 and 61, through 'very clayey' sand in 47 NW 62 and 47 SW 18, to gravel overlying 'clayey' pebbly sand in 47 NW 58. The fine and coarse gravel in the last borehole comprises subrounded to well-rounded Carboniferous

limestone and sandstone, with some Triassic mudstone and sandstone, chert, Palaeozoic mudstone and trace amounts of Magnesian Limestone and quartz; the sand fraction contains coarse lithic grains with fine-grained quartz. In all other boreholes the mineral comprises mainly fine quartz sand.

River terrace deposits Mineral within these deposits has a mean grading of 3 per cent fines, 25 per cent sand and 72 per cent gravel. The gravel fraction commonly comprises almost equal proportions of fine and coarse pebbles, with cobbles. Well-rounded Carboniferous limestone is the dominant constituent, but a significant quantity of subrounded to rounded Carboniferous sandstone is also present. A small percentage of chert often occurs, together with traces of Triassic sandstone, Permian mudstone, Palaeozoic siltstone, and ironstone. The sand fraction is medium to coarse-grained, subangular to subrounded quartz with lithic grains, the latter being prominent in the coarser grades.

Alluvium With the exception of 'very clayey' sand encountered in borehole 37 NW 36, mineral within this deposit is confined to the floodplains of the River Ure, its tributaries the Laver and Skell, and the River Swale. The mean grading of the deposit is 12 per cent fines, 52 per cent sand and 36 per cent gravel ('clayey' sandy gravel), but there is considerable variation of grade.

In the Ure valley, alluvium comprises gravel up to 8.0 m thick (borehole 37 SW 103). The gravel fraction consists of fine and coarse pebbles, with some cobbles, of rounded to well-rounded Carboniferous limestone and sandstone, with some chert, Magnesian Limestone and Palaeozoic mudstone and trace amounts of Triassic sandstone and igneous rocks. Sand within the deposit is fine to coarse-grained, subangular to subrounded quartz, with lithic grains in the coarse fraction.

By comparison, mineral-bearing alluvium of the Swale is generally thin and predominantly fine-grained, although variations of grade from 'very clayey' sand (e.g. borehole 47 SW 36) to gravel (e.g. borehole 37 NE 33) were encountered. The composition of the sand and gravel is similar to that of the Ure although a slightly greater percentage of Triassic lithologies is present.

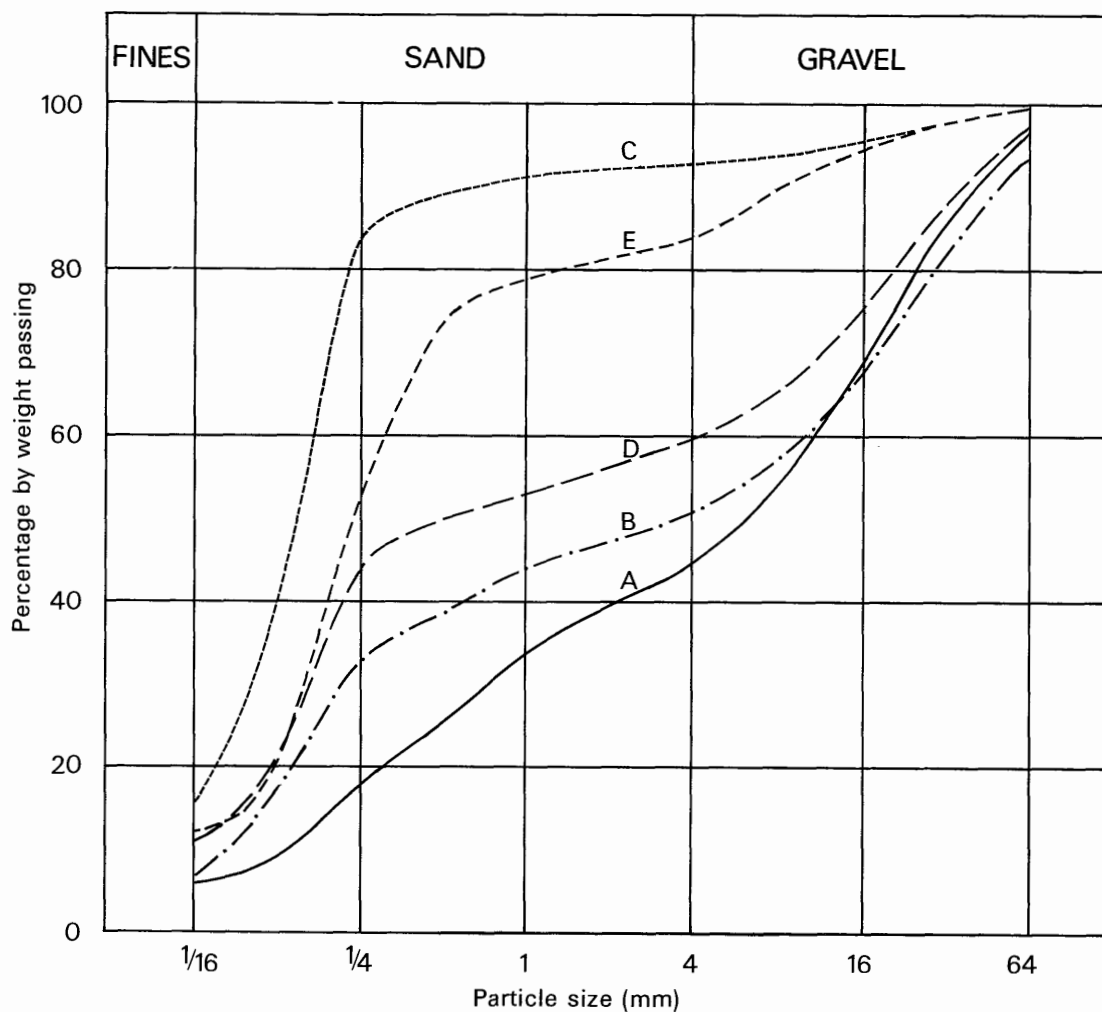
The Map

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

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 Survey's field staff. The geological boundaries are the best interpretation of the information available at the time of survey. However, local irregularities and discrepancies may be revealed as new evidence from boreholes and excavations becomes available.

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

Mineral resource information For assessment purposes, the district is divided into resource blocks (see Appendix A) which, apart from block E, are subdivided into areas where mineral is 'exposed' and areas where mineral is present beneath overburden. Because of the complex drift relationships at the surface in the north-



Block	Percentages by weight						
	$-\frac{1}{16}$ mm	$+\frac{1}{16}$ mm $-\frac{1}{4}$ mm	$+\frac{1}{4}$ mm -1 mm	$+1$ mm -4 mm	$+4$ mm -16 mm	$+16$ mm -64 mm	$+64$ mm
A	6	12	16	11	24	27	4
B	7	26	11	7	17	26	6
C	16	68	7	2	3	4	0
D	11	32	10	7	15	22	3
E	12	40	27	5	11	5	0

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

east of the district in the area of block E, these two categories have not been differentiated, and a category embracing both 'exposed' mineral and mineral beneath overburden has been introduced. A fourth category covers areas where sand and gravel is absent or not potentially workable. The mineral is identified as 'exposed' where the overburden, commonly consisting only of soil and subsoil, averages less than 1.0 m in thickness. Areas where bedrock crops out, where boreholes indicate absence of sand and gravel beneath cover, and where sand and gravel beneath cover is interpreted to be not potentially workable are uncoloured on the map. In such areas it has been assumed that mineral is absent except in infrequent and relatively minor patches that can neither be outlined nor assessed quantitatively

in the context of this survey.

Areas of unassessed sand and gravel, for example in built-up areas, are indicated by a red stipple.

Where possible, the limits of the different categories of deposits are based on the mapped geological boundaries. Where there is a transition from one category to another which is independent of the geological lines and which could not be accurately delineated during this survey, inferred boundaries have been inserted. Such boundaries are shown by a distinctive zigzag symbol. 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 cartographical considerations. For the purpose of measuring area the centre-line of the symbol is used.

Table 4 The sand and gravel resources of sheet SE 37 and part of SE 47: statistical assessment.

Block	Area		Mean thickness			Volume of sand and gravel			Mean grading percentage		
	Block	Mineral	Overburden	Mineral	Waste between mineral	Limits at the 95% probability level			Fines	Sand	Gravel
						km ²	km ²	m			
	± 1/16 mm	± 1/4 mm	± 4 mm								
A	14.8	9.6	1.9	10.2	0.4	98	56	55	6	39	55
B	60.8	8.8	2.4	3.9	0.0	34	48	18	7	44	49
C	16.8	15.6	2.4	11.0	1.2	172	33	56	16	77	7
D	21.3	21.0	1.7	6.2	0.3	130	40	52	11	49	40
E	32.9	3.9	0.4	1.1	0.0	4	speculative		12	72	16
A-E	146.6	58.9	1.9	7.7	0.5	438	22	97	11	55	34

Results

The statistical results are summarised in Table 4. Fuller grading particulars are shown in Figures 4 to 9 and Tables 5 to 9; the cumulative grading curves are based on up to 11 data points.

Accuracy of results For resource blocks A to D the accuracy of the results at the symmetrical 95 per cent probability level (that is, on average nineteen out of every twenty sets of limits constructed in this way contain the true value for the volume of mineral) varies between 33 and 56 per cent (Appendix B). However, the true values are more likely to be nearer the figures estimated than either of the limits. Moreover, it is probable that approximately the same percentage limits would apply for the estimate of volume of a very much smaller parcel of ground (say 100 hectares) containing similar sand and gravel deposits, if the results from the same number of sample points were used in the calculation. Thus, if closer limits are needed for quotation of reserves it can be expected that data from more points will be required, even if the area is quite small.

However, it must be emphasised that the quoted volume of sand and gravel bears no simple relationship to the amount that could be extracted in practice, for no allowance has been made in the calculations for any restraints (such as existing buildings and roads) on the use of land for mineral working.

Notes on the Resource Blocks

The potentially workable sand and gravel deposits of the district have been divided into five resource blocks. Four have been assessed at the indicated level; an inferred assessment is offered for block E (see Introduction). Block A includes sand and gravel of unknown age together with the fluvial and fluvio-glacial deposits in and adjacent to the valley of the River Ure; block B encompasses fluvial, fluvio-glacial and glacial deposits in the northwest of the district and a large generally barren area of high ground in the centre of sheet SE 37; blocks C and D together delimit glacial sand and gravel within the esker and adjacent but subordinate fluvial deposits; block E contains sand of glacial lake deposits (including penecontemporaneous fluvial deposits). IMAU and other boreholes (including many confidential records) in the centre and south of sheet SE 37 and in the east of the district proved these areas to be generally barren; inferred boundaries have been inserted accordingly.

Block A (Table 5, Figure 5)

This block includes 9.6 km² of mainly exposed mineral in the valley of the River Ure around and north of the

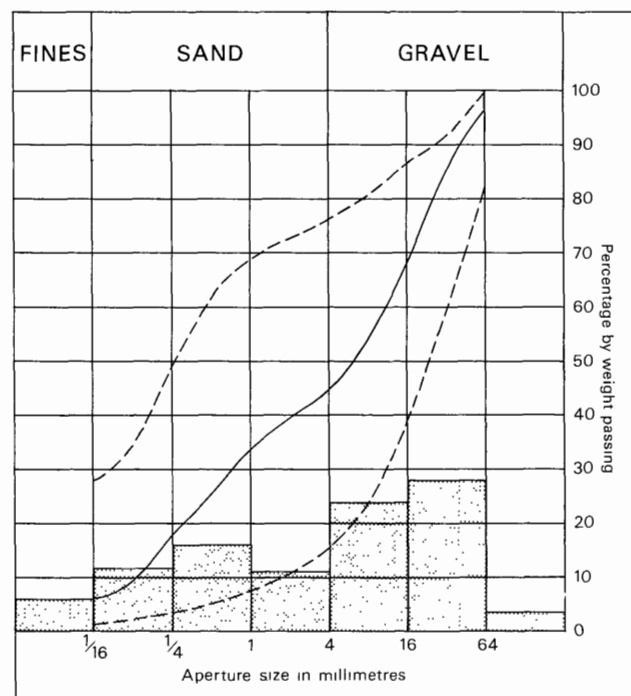


Figure 5 Grading characteristics of the mineral in block A. The continuous line is the cumulative frequency curve for the mean grading of the block as a whole; the broken lines denote the envelope within which the mean grading curves for individual boreholes fall. The mean grading of the block is also shown as a histogram.

unassessed urban area of Ripon. Potentially workable deposits comprise sand and gravel of unknown age, fluvio-glacial terrace deposits and fluvial deposits of the rivers Ure, Laver and Skell.

The assessment of resources is based on one measured exposure, 11 IMAU boreholes and 63 other boreholes. Combined thicknesses of mineral within these range from 1.0 to 21.5 m, with a mean thickness of 10.2 m. Four IMAU boreholes failed to reach the base of the mineral within sand and gravel of unknown age, but geophysical evidence (see Appendix F) suggests that the maximum proven thickness is close to the maximum true thickness.

The estimated volume of mineral in the block is 98 million m³ ± 55 million m³. Gravel predominates although mineral grade ranges from 'clayey' sand (e.g. in

Table 5 Block A: data from IMAU boreholes

Borehole	Recorded thickness			Mean grading percentage						
	Overburden m	Mineral m	Waste between mineral m	Fines	Sand			Gravel		
				- $\frac{1}{16}$ mm	Fine + $\frac{1}{16}$ - $\frac{1}{4}$ mm	Medium + $\frac{1}{4}$ -1 mm	Coarse +1-4 mm	Fine +4-16 mm	Coarse +16-64 mm	Cobble +64 mm
37 NW 45	0.2	19.5	0.8	11	39	20	7	10	10	3
37 NW 47	10.9	14.1+		3	5	12	6	32	38	4
37 NW 50	0.4	15.8+	4.5	5	3	15	13	29	33	2
37 NW 51	1.7	2.4		2	2	4	8	23	44	17
37 NW 55	0.7	6.5		5	5	26	10	21	30	3
37 NW 56	0.5	4.2		2	3	8	15	38	32	2
37 SW E1*		7.0+		7	9	24	8	16	28	8
37 SW 100	2.2	12.0		3	3	11	11	29	37	6
37 SW 101	1.2	1.8		2	2	11	7	29	49	0
37 SW 103	0.5	21.5+	0.5	7	14	20	15	19	22	3
37 SW 106	0.1	21.3+		4	8	13	14	30	30	1
37 SW 111	1.2	1.4		28	12	7	4	10	22	17
Mean				6	12	16	11	24	28	3

The + sign indicates that the full thickness of mineral was not proved in the borehole.

* Exposure.

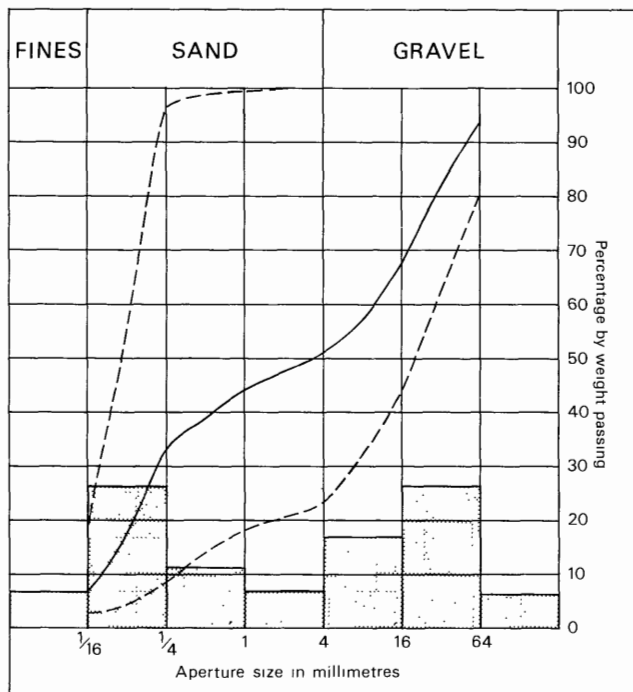


Figure 6 Grading characteristics of the mineral in block B (for explanation see Figure 5).

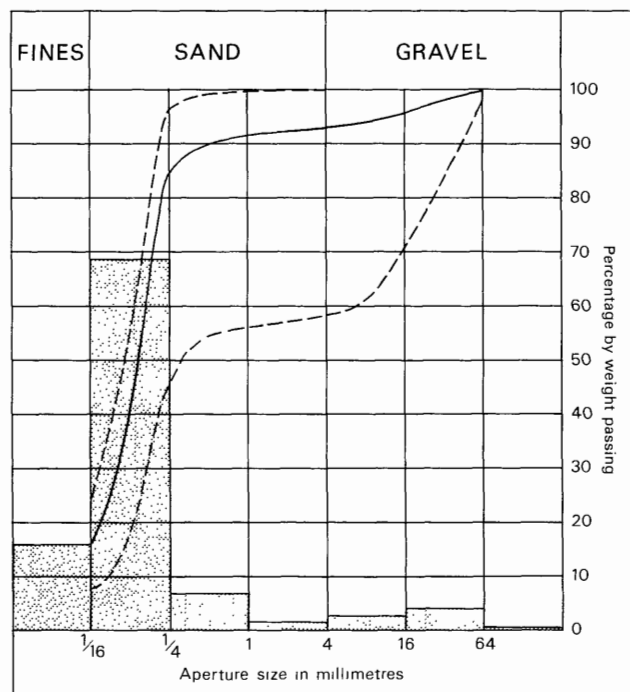


Figure 7 Grading characteristics of the mineral in block C (for explanation, see Figure 5).

borehole 37 NW 45) to gravel. The mean grading of the mineral for the block is 6 per cent fines, 39 per cent sand and 55 per cent gravel. Overburden, consisting of alluvial silt, clay, peat and less commonly till, has an average thickness of 1.9 m. The maximum overburden thickness encountered was 10.9 m in borehole 37 NW 47, in which a thick layer of till overlies sand and gravel of unknown age. Elsewhere, the overburden is generally thin except to the east of Ripon, where it thickens perceptibly (e.g. boreholes 37 SW 6 and 8) and an inferred boundary has been inserted between exposed and concealed mineral. Interbedded waste is up to 4.5 m thick (borehole 37 NW 50) but the mean thickness for the block is 0.4 m.

Block B (Table 6, Figure 6)

Block B encompasses 60.8 km² of the centre and north-west of sheet SE 37. Several separate areas of potentially workable deposits in the north of the block combine to produce 8.8 km² of largely concealed mineral. Four isolated boreholes (37 NE 17, IMAU borehole 37 NE 40, 37 SW 41 and 37 SW 45) located in the generally barren central and southern parts of the block encountered mineral, but these deposits are thin and appear to be of limited extent in an area dominated by clayey sediments; thus they have been excluded from the assessment. Within this generally barren area, small outcrops of sand of glacial lake deposits, and of glacial sand and gravel, have been mapped, but they are too small and scattered

to be assessed; these are indicated on the resource map with a red stipple.

The potentially workable deposits include glacial sand and gravel, fluvio-glacial deposits and alluvium. Only one borehole, 37 NW 36, proved mineral in alluvium; other boreholes in alluvium encountered only clay and silt (e.g. 37 NW 38). Boreholes 37 NW 41 and 46, although sited in an area of thin fluvio-glacial terrace deposits, failed to prove mineral. Because of these exceptions inferred boundaries have been inserted where appropriate.

Nine IMAU boreholes and 13 others were included in the assessment of resources. Two of these (37 NW 13 and 37 NW 34) failed to encounter mineral and this has been taken into account by entering nil thicknesses in the volume calculations. Borehole 37 NW 34 proved no mineral in an area mapped as fluvio-glacial deposits, but a confidential record of a nearby borehole indicates this to be a potentially workable deposit. The combined thicknesses of mineral range from 1.1 to 11.9 m. The mean of 3.9 m produces an estimate of volume of 34 million m³ ±18 million m³.

The mean grading of potentially workable deposits in the block is 7 per cent fines, 44 per cent sand and 49 per cent gravel. Six IMAU boreholes proved gravel; boreholes 37 NW 36, 44 and 52 proved 3.9 m of 'very clayey'

sand, 1.3 m of 'clayey' sand (in part) and 4.9 m of pebbly sand respectively. Overburden, with a mean thickness of 2.4 m, may locally (e.g. 37 NW 42) reach as much as 9.3 m thick in glacial drift. A waste parting of 0.4 m was noted in borehole 37 NW 44.

An inferred boundary has been drawn along part of the southern margin of the block to accord with the adjoining Boroughbridge resource sheet (Abraham, 1981), where mineral is shown underlying till. In the Ripon district no mineral underlies the till in this locality.

Block C (Table 7, Figure 7)

This block, comprising 15.6 km² of exposed and concealed mineral, occupies a central position within the district, between Skipton-on-Swale [366 798] and Dishforth [382 732]. The chief potentially workable deposits are found within glacial sand and gravel which, together with other sediments, conceals a buried valley containing thick deposits of sand and gravel of unknown age (e.g. in boreholes 37 NE 16, 19, 53, 56 and 47 NW 8). The position and extent of this valley is discussed by Cooper (1983) and Benfield (1983). Mineral within sand of glacial lake deposits and within alluvium is subordinate both in thickness and extent; the former is usually less

Table 6 Block B: data from IMAU boreholes

Borehole	Recorded thickness			Mean grading percentage							
	Overburden	Mineral	Waste between mineral	Fines	Sand			Gravel			
				- $\frac{1}{16}$ mm	Fine + $\frac{1}{16}$ - $\frac{1}{4}$ mm	Medium + $\frac{1}{4}$ -1 mm	Coarse +1-4 mm	Fine +4-16 mm	Coarse +16-64 mm	Cobble +64 mm	
37 NW 34		absent									
37 NW 36	2.0	3.9		19	77	4	0	0	0	0	
37 NW 38	3.1	1.7		6	10	6	7	32	36	3	
37 NW 39	3.2	2.7		3	7	21	10	26	28	5	
37 NW 40	0.2	1.6		8	7	14	15	26	26	4	
37 NW 42	9.3	5.2		4	4	12	7	17	37	19	
37 NW 44	7.0	6.1	0.4	6	14	16	9	16	33	6	
37 NW 52	1.5	4.9		3	65	8	5	9	9	1	
37 NE 36	5.2	2.8		4	7	6	5	30	45	3	
Mean				7	26	11	7	17	26	6	

Table 7 Block C: data from IMAU boreholes

Borehole	Recorded thickness			Mean grading percentage							
	Overburden	Mineral	Waste between mineral	Fines	Sand			Gravel			
				- $\frac{1}{16}$ mm	Fine + $\frac{1}{16}$ - $\frac{1}{4}$ mm	Medium + $\frac{1}{4}$ -1 mm	Coarse +1-4 mm	Fine +4-16 mm	Coarse +16-64 mm	Cobble +64 mm	
37 NE 33	2.7	3.8		11	35	11	2	12	28	1	
37 NE 34	0.8	15.0	3.2	18	78	3	1	0	0	0	
37 NE 35	0.5	21.8	2.1	14	75	10	1	0	0	0	
37 NE 38		absent									
37 NE 43	8.7	4.4		18	78	3	1	0	0	0	
37 NE 45	0.4	8.7+		11	55	28	3	2	1	0	
37 NE 46	0.2	4.2	6.1	9	37	16	8	15	13	2	
37 NE 47	8.0	5.5	3.5	24	58	8	4	4	2	0	
37 NE 50	0.3	17.3	4.4	17	70	4	2	3	4	0	
37 NE 52	0.3	14.1	0.7	17	69	1	1	3	7	2	
37 SE 41	2.0	8.3		24	71	2	1	2	0	0	
37 SE 45	1.6	9.9	6.1	7	74	2	1	5	11	0	
37 SE 48	2.0	2.8		24	64	8	3	1	0	0	
Mean				16	68	7	2	3	4	0	

The + sign indicates that the full thickness of mineral was not proved in the borehole

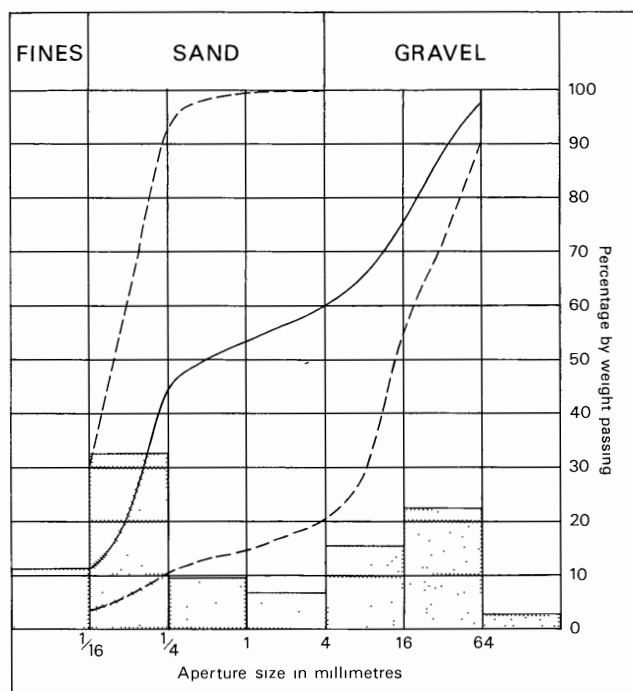


Figure 8 Grading characteristics of the mineral in block D (for explanation, see Figure 5).

than 1 m thick and is only classified as potentially workable where it overlies thicker glacial mineral.

Thirteen IMAU and 17 pre-existing boreholes recorded between 1.2 m (37 SE 136) and 27.8 m (37 NE 56) of mineral; three of these (37 NE 45, 22a and b) failed to reach the base of the deposit. One IMAU borehole (37 NE 38) and four others, failed to prove mineral; this absence of mineral has been taken into account by entering nil thicknesses in the volume calculations. The mean thickness of mineral is 11.0 m, giving a volume estimate of 172 million m³ ± 56 million m³.

The majority of boreholes proved mineral ranging in grade from 'very clayey' sand to sand, producing a mean grading of 16 per cent fines, 77 per cent sand and 7 per cent gravel. Boreholes 37 NE 33, 46, 50 and 52 each proved between 1.7 and 2.2 m of gravel beneath thicker deposits of sand.

Overburden, where present, ranges from 0.3 to 11.0 m thick with a mean of 2.4 m. Waste between mineral deposits has a mean thickness of 1.2 m but locally may reach as much as 6.1 m (e.g. in 37 SE 45).

Block D (Table 8, Figure 8)

Situated in the south-east of the district, between Asenby [397 753] and Brafferton [438 701], this block contains 21.0 km² of mineral-bearing ground. Potentially workable deposits, both exposed and concealed, were proved in glacial sand and gravel (the main resource in the block), sand of glacial lake deposits and alluvium. Mineral within alluvium is confined to the floodplain of the River Swale, where borehole 47 SW 36 proved 'very clayey' sand to 7.5 m below ground level and borehole 47 SW 32 proved 3.5 m of 'clayey' sandy gravel beneath 1.6 m of alluvial silt and clay. Several metres of sand are visible in the river banks between these two boreholes; geophysical evidence (Appendix F) suggests that alluvial mineral thins rapidly away from the meander belt of the river. With the exception of 6.5 m of 'very clayey' sand encountered in borehole 47 SW 18, sand of glacial lake deposits is generally thin and classified as mineral only where it overlies thicker glacial mineral.

The buried valley referred to in the description of block C continues southwards beneath glacial deposits in the eastern part of block D (Benfield, 1983). However, boreholes sited along the conjectural course of this valley failed to prove mineral within sand and gravel of unknown age (e.g. boreholes 47 SW 18, 47 SW 33). Geophysical soundings taken at Thornton Bridge [433 714], Far Ings [424 740] and Eldmire [419 744], whilst confirming the existence of the buried valley, appear to infer the presence of sand and gravel deposits at depth (see Appendix F). The thickness and quality of these deposits remains unknown and the evidence of

Table 8 Block D: data from IMAU boreholes

Borehole	Recorded thickness			Mean grading percentage						
	Overburden m	Mineral m	Waste between mineral m	Fines	Sand			Gravel		
				- $\frac{1}{16}$ mm	+ $\frac{1}{16}$ - $\frac{1}{4}$ mm	+ $\frac{1}{4}$ -1 mm	Coarse +1-4 mm	Fine +4-16 mm	Coarse +16-64 mm	Cobble +64 mm
37 NE 51	8.0	5.4+		4	8	3	6	34	44	1
37 SE 42	0.4	9.5		6	13	8	9	20	34	10
37 SE 46	0.7	7.1		5	14	8	9	23	37	4
47 SW 16	2.6	5.6		11	7	5	11	29	33	4
47 SW 17		absent								
47 SW 18	0.2	6.5	1.9	30	62	7	1	0	0	0
47 SW 21	0.4	6.5		16	51	4	3	6	16	4
47 SW 22		absent								
47 SW 26		absent								
47 SW 27	4.1	4.8		5	54	12	3	10	15	1
47 SW 28	1.4	3.7		6	4	9	9	30	38	4
47 SW 29	3.1	1.2		10	24	12	6	17	31	0
47 SW 31	3.6	9.2	0.7	14	77	5	1	1	2	0
47 SW 32	4.6	9.1	2.1	7	16	17	13	24	22	1
47 SW 34	1.0	1.6		12	80	8	0	0	0	0
47 SW 35		absent								
47 SW 36	0.3	16.4+		14	29	15	9	11	21	1
Mean				11	33	9	7	15	22	3

The + sign indicates that the full thickness of mineral was not proved in the borehole

Table 9 Block E: data from IMAU boreholes

Borehole	Recorded thickness			Mean grading percentage						
	Overburden m	Mineral m	Waste between mineral m	Fines	Sand			Gravel		
				- $\frac{1}{8}$ mm	Fine + $\frac{1}{8}$ - $\frac{1}{4}$ mm	Medium + $\frac{1}{4}$ -1 mm	Coarse +1-4 mm	Fine +4-16 mm	Coarse +16-64 mm	Cobble +64 mm
47 NW 57	1.5	1.5		11	72	15	2	0	0	0
47 NW 58	2.1	2.8		6	9	33	10	27	14	1
47 NW 61	0.3	2.1		16	57	23	3	1	0	0
47 NW 62	0.2	1.1		24	41	30	4	1	0	0
Mean				12	40	26	6	11	5	0

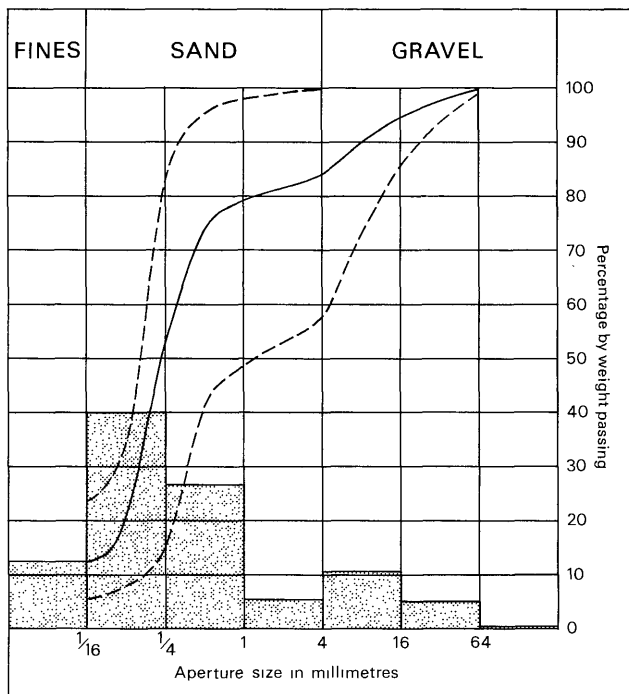


Figure 9 Grading characteristics of the mineral in block E (for explanation, see Figure 5).

these soundings should, in any case, be treated with caution.

Of the 17 IMAU boreholes and 62 others that were used in the assessment of resources, two did not reach the base of the mineral deposit and five failed to prove mineral. Allowance has been made for the latter by entering nil thicknesses in the volume calculations. The maximum proven mineral thickness is 18.6 m in borehole 47 SW 1. The mean thickness of 6.2 m gives an estimate of mineral volume of 130 million m³ ±52 million m³.

The mineral grade ranges from 'very clayey' sand to gravel, with the latter predominating, particularly in glacial sand and gravel. The overall mean grading for the block, however, is 11 per cent fines, 49 per cent sand and 40 per cent gravel, which classifies it as 'clayey' sandy gravel.

Overburden, where present, reaches a maximum thickness of 13.1 m (borehole 47 SW 6), with a mean of 1.7 m. Waste partings between mineral deposits occur sporadically and have a mean thickness of 0.3 m.

An inferred boundary has been drawn along a part of the block's southern margin to accord with the adjoining Tholthorpe resource sheet (Stanczyszyn 1982), where concealed mineral was not proved locally.

Block E (Table 9, Figure 9)

Widespread outcrops of sand of glacial lake deposits are mapped within this 32.9 km² resource block, which is situated in the east of the district. However, IMAU and other boreholes, with isolated exceptions such as boreholes 37 NE 39 and 47 NW 72, proved much of the area to be barren. Only in a small area (3.9 km²) on the northern margin of the block is sand of glacial lake deposits sufficiently thick and continuous to be con-

Sand and gravel workings

Table 10 List of active and abandoned workings

	O.S Sheet	Location	Grid Reference	Deposit Worked
Active	SE 37	Ripon	3025 7058	Fluvio-glacial Terrace Deposits
Abandoned	SE 37	Topcliffe Station	3844 7947	Glacial Sand and Gravel
	SE 37	The Leys	3716 7929	Glacial Sand and Gravel
	SE 37	West Lodge	3813 7706	Glacial Sand and Gravel
	SE 37	Ripon	3035 7155	Fluvio-glacial Terrace Deposits
	SE 37	Ripon	3196 7048	River Terrace Deposits
	SE 37	Asenby	3968 7500	Glacial Sand and Gravel
	SE 37	Asenby	3954 7522	Glacial Sand and Gravel
	SE 37	Asenby	4000 7526	Glacial Sand and Gravel
	SE 47	Asenby	4015 7515	Glacial Sand and Gravel
	SE 47	The Carr	4116 7432	Glacial Sand and Gravel
	SE 47	Thorpefield	4200 7965	Sand of Glacial Lake Deposits
	SE 47	Poplar Hill	4070 7480	Glacial Sand and Gravel

sidered potentially workable. The assessment of resources is based on four IMAU boreholes and 21 others, of which 11 proved no mineral. The area of barren ground cannot be delimited, but nil thicknesses for three boreholes have been entered in the mineral volume calculations. Mineral thickness ranges from 1.0 m to a proven maximum of 3.5 m; the average of 1.1 m gives a speculative estimate of volume of 4 million m³. Three boreholes proved sand to 'very clayey' sand, and one (47 NW 58) gravel overlying 'clayey' pebbly sand. The mean grading for the block is 12 per cent fines, 72 per cent sand and 16 per cent gravel.

Overburden, where present, is very variable up to 2.8 m thick with an average of 0.4 m. No attempt has been made to separate areas with exposed mineral from mineral beneath overburden, or areas that may not contain mineral. Thus a single category of 'exposed mineral and continuous or almost continuous spreads of mineral beneath overburden, undifferentiated' has been adopted.

Conclusions

The chief source of potentially workable sand and gravel within the district is glacial sand and gravel in the esker between Skipton-on-Swale and Brafferton. However, this is a complex body, and boreholes penetrating it reveal considerable and irregular, vertical and lateral variation, which includes till and laminated clay closely associated with glacial deposits as well as glacial sand and gravel that may itself comprise material that cannot be classified as mineral.

Secondary, but important, sources of potentially workable sand and gravel are the fluvial, fluvio-glacial and subjacent sand and gravel of unknown age in the valley of the River Ure. As sources of aggregate, sand of glacial lake deposits, and the alluvium of the River Swale, are subordinate in extent, thickness and quality.

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APPENDIX A

FIELD AND LABORATORY PROCEDURES

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

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

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

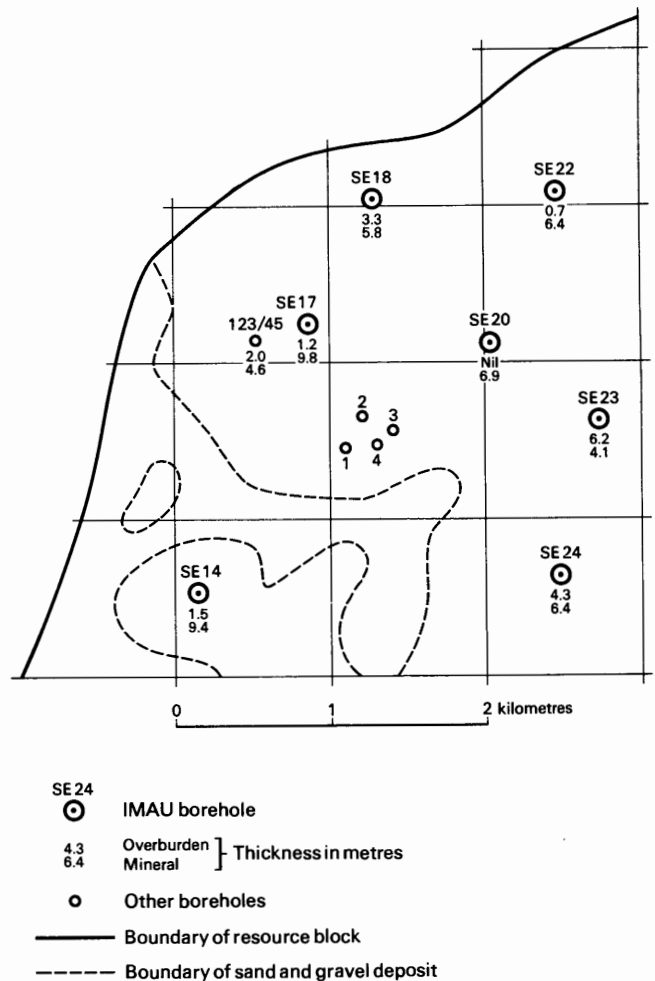
The drilling machine employed should be capable of providing a continuous sample representative of all unconsolidated deposits, so that the in-situ grading can be determined, if necessary, to a depth of 30 m (100 ft) at a diameter of about 200 mm (8 in), beneath different types of overburden. It should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

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

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

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

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



Example of resource block assessment: map of a fictitious block

APPENDIX B

STATISTICAL PROCEDURE

Statistical assessment

1 A statistical assessment is made of an area of mineral greater than 2 km², if there are at least five evenly spaced boreholes in the resource block (for smaller areas, see Paragraph 12 below).

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

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

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

4 The above relationship may be transposed such that

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

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

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

5 Given that the number of approximately evenly spaced sample points in the sampled area is n with mineral thickness measurements $l_{m1}, l_{m2}, \dots, l_{mn}$, then the best estimate of mean thickness, \bar{l}_m , is given by

$$\bar{l}_m = (l_{m1} + l_{m2} + \dots + l_{mn}) / n.$$

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

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

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

6 The sampled area in each resource block is coloured pink on the map. Wherever possible, calculations relate to the mineral within mapped geological boundaries (which may not necessarily correspond to the limits of a deposit). Where the area is not defined by a mapped boundary, that is, where the boundary is inferred, a distinctive symbol is used. Experience suggests that the errors in determining area are small relative to those in thickness. The relationship $S_A / S_{\bar{l}_m} \leq 0.3$ is assumed in all cases. It follows from Equation [2] that

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

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

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

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

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

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

$$L_{\bar{l}_m} \leq L_V \leq 1.05 L_{\bar{l}_m}.$$

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

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

per cent,

and when n is greater than 20, as

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

per cent.

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

Inferred assessment

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

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

14 No assessment is attempted for an isolated area of mineral less than 0.25 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 needs to be only approximately regular and in estimating the mean thickness only simple weighting is necessary. In practice, equal weighting can often be applied to thicknesses at all sample points. If, however, there is a distinctly unequal distribution of points, bias is avoided by dividing the sampled area into broad zones, to each of which a value roughly proportional to its area is assigned. This value is then shared between the data points with the zone as the weighting factor.

Block calculation

Scale: 1:25 000
Block: Fictitious

Area
Block: 11.08 km²
Mineral: 8.32 km²

Mean thickness
Overburden: 2.5 m
Mineral: 6.5 m

Volume
Overburden: 21 million m³
Mineral: 54 million m³

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

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

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

Calculation of confidence limits

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

$$\Sigma (wl_m - \overline{wl_m})^2 = 15.82$$

$$n = 8$$

$$t = 2.365$$

L_v is calculated as

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

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

$$= 20.3$$

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

APPENDIX C

CLASSIFICATION AND DESCRIPTION OF SAND AND GRAVEL

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

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

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

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

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

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

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

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

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

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

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

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

The relative proportions of the rock types present in the gravel fraction are indicated by the use of the words 'and' or 'with'. For example, 'flint and quartz' indicates roughly equal proportions with neither constituent accounting for less than about 25 per cent of the whole; 'flint with quartz' indicates that flint is dominant and quartz, the principal accessory rock type, comprises 5 to 25 per cent of the whole. Where the accessory material accounts for less than 5 per cent of the whole, but is still readily apparent, the phrase 'with some' has been used. Rare 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, 1975), are as follows.

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

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

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

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

Well rounded: 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.

Classification of gravel, sand and fines

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

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

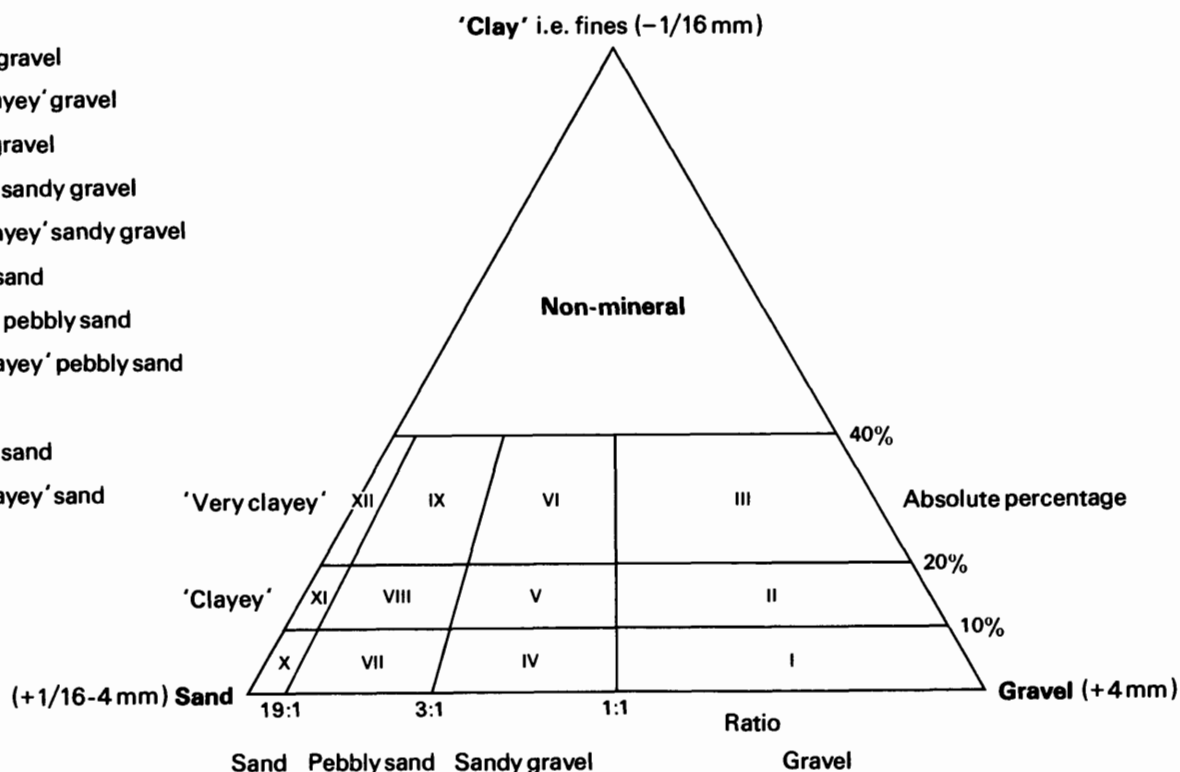


Diagram showing the descriptive categories used in the classification of sand and gravel

APPENDIX D

EXPLANATION OF THE BOREHOLE RECORDS

Annotated Example

SE 37 NE 47	3974 7698	Providence Hill¹	Block C
Surface level ² +29.3 m (+96 ft)			Overburden ⁵ 8.0 m
Water not struck ³			Mineral 3.5 m
Shell and auger 200 mm ⁴			Waste 3.5 m
September 1982			Mineral 2.0 m
			Waste 1.0 m
			Bedrock 0.5 m+ ⁶

LOG

Geological classification	Lithology ⁷	Thickness m	Depth m
	Soil	0.2	0.2
Till	Clay, moderate brown ⁸ , stony; pebbles of Carboniferous sandstone and limestone	2.5	2.7
Glacial Sand and Gravel	Clayey sand, pale reddish brown; fine quartz; some clay bands	1.4	4.1
	Clay, moderate reddish brown; silty	2.1	6.2
	Clay, moderate brown; laminated	1.0	7.2
	Silt, moderate reddish brown; clay bands	0.8	8.0
	a 'Very clayey' sand, mainly fine	3.5	11.5
	Silt, sandy, moderate reddish brown	3.5	15.0
	b 'Clayey' pebbly sand, Gravel: fine, rounded Carboniferous sandstone and limestone, trace of Triassic sandstone Sand: mainly fine angular, quartz, with some limestone	2.0	17.0
Till	Clay, moderate reddish brown; soft; rounded pebbles of red sandstone	1.0	18.0
Sherwood Sandstone Group	Sandstone, moderate reddish brown; recovered as fragments	0.5+	18.5

GRADING⁹

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines			Sand			Gravel
	-	+	-		- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
a	29	71	0	8.0-11.5	29	67	3	1	0	0	0
b	15	70	15	15.0-17.0	15	41	18	11	11	4	0
a+b	24	70	6	Mean	24	58	8	4	4	2	0

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

1 Location

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

2 Surface level

The surface level at the borehole site is given in metres and feet above Ordnance Datum.

3 Groundwater conditions

If groundwater was present, the level at which it was encountered or the level at which it stood on the completion of drilling is normally given (in metres relative to Ordnance Datum).

4 Type of drill and date of drilling

All boreholes were drilled by a shell and auger rig using 250 mm, 200 mm and/or 150 mm casing. The month and year of completion of drilling are stated.

5 Overburden, mineral, waste and bedrock

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

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

7 Lithological description

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

8 Colour

The colour name has been deduced by reference to a modified system based on the Rock-Color Chart (Geological Society of America Rock-Color Chart Committee, 1975). A numerical designation, in brackets, may follow the colour name in some parts of the report.

9 Grading data

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

For each bulk sample the percentages of fines ($-\frac{1}{8}$ mm), fine sand ($+\frac{1}{8}-\frac{1}{4}$ mm), medium sand ($+\frac{1}{4}-1$ mm), coarse sand ($+1-4$ mm), fine gravel ($+4-16$ mm), coarse and ($+16-64$ mm) and cobble gravel ($+64$ mm) are stated.

The mean grading of groups of samples making up an identified mineral horizon is also given in detail and in summary. Where more than one horizon is recognised the mean grading for the whole of the mineral in the borehole may be given. Where necessary, in calculating mean gradings, data for individual samples are weighted by the thickness represented. If, exceptionally, grading results are not available for a sample, an attempt may be made to estimate the grading by comparing the grading and field descriptions of adjacent samples with the sample in question. Such estimates are shown in square brackets.

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

APPENDIX E

INDUSTRIAL MINERALS ASSESSMENT UNIT BOREHOLE AND SECTION RECORDS

SE 37 NW 34 3078 7984 Duskhills **Block B**
 Surface level +38.7 m (+127 ft) Waste 5.9 m
 Water struck at +32.8 m Bedrock 0.1 m+
 Shell and auger 200 mm
 November 1982

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.7	0.7
Fluvio-glacial Terrace Deposits	'Clayey' sandy gravel Gravel: fine with coarse, rounded to subrounded; Carboniferous limestone with sandstone and some chert, quartzite and quartz Sand: medium with coarse, subrounded, lithic grains, with quartz Fines: pale brown silt and clay	0.6	1.3
	Clay, dark yellowish brown, sandy, stoneless, soft to firm; thin bands of greyish red clay	0.3	1.6
Laminated Clay	Clay and silt, medium dark grey, laminated, stoneless, firm	1.2	2.8
Till	Clay, silty, stony, dark reddish brown, firm; Permian and Triassic clasts predominant with some rounded Carboniferous limestone and sandstone pebbles and cobbles; abundant angular marl fragments at base	3.1	5.9
Upper Permian Marl	Mudstone, very hard, dark reddish brown	0.1+	6.0

SE 37 NW 35 3157 7957 Headlands Lane, Sutton Howgrave **Block B**
 Surface level +49.0 m (+161 ft) Waste 2.7 m
 Water not struck Bedrock 0.2 m+
 Shell and auger 250 mm
 October 1982

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
	Made ground	1.1	1.3
Till	'Clayey' sand Sand: fine, rounded, quartz with lithic grains Fines: moderate reddish brown silt and clay	0.7	2.0
	Clay, very sandy, moderate reddish brown; clasts comprise Permian mudstone and Triassic sandstone; pods and lenses of sand	0.7	2.7
Sherwood Sandstone Group	Sandstone, moderate reddish brown, fine-grained	0.2+	2.9

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
12	88	0	1.3-2.0	12	80	5	3	0	0	0

SE 37 NW 36	3240 7926	Howgrave Grange	Block B
Surface level +36.0 m (+118 ft)			Overburden 2.0 m
Water struck at +33.3 m			Mineral 3.9 m
Shell and auger 200 mm			Waste 3.7 m
December 1982			Bedrock 0.4 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.5	0.5
Alluvium	Clay, dark grey, interlaminated with strong yellowish orange silt; stoneless, soft	0.2	0.7
	Clay, very sandy; greyish red	1.3	2.0
	'Clayey' sand Sand: fine, subangular to subrounded quartz Fines: moderate yellowish brown, silt and clay	3.9	5.9
	Clay, greyish brown; laminated, soft, stoneless	1.5	7.4
Till	Clay, sandy, stony; moderate brown, becoming dark reddish brown with depth; micaceous; sporadic Carboniferous clasts	2.2	9.6
Sherwood Sandstone Group	Sandstone, dark reddish brown, hard, medium-grained, micaceous	0.4+	10.0

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
19	81	0	2.0-5.9	19	77	4	trace	0	0	0

SE 37 NW 37 3296 7992 Kirklington Grange Block B

Surface level +37.8 m (+124 ft)
 Water struck at +35.3 m
 Shell and auger 200 mm
 November 1982

Waste 3.8 m
 Bedrock 1.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
Till	'Clayey' sand Sand: fine, subrounded; quartz; micaceous Fines: moderate reddish brown, silt and clay	3.4	3.8
Sherwood Sandstone Group	Sandstone, moderate reddish brown, hard, fine-grained	1.0+	4.8

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines	Sand		Gravel			
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
18	80	2	0.4-3.8	18	77	2	1	2	0	0

SE 37 NW 38 3320 7894 North of Middleton Quernhow Block B

Surface level c.+37.0 m (+121 ft)
 Water struck at +33.9 m
 Shell and auger 200 mm
 December 1982

Overburden 3.1 m
 Mineral 1.7 m
 Waste 6.2 m
 Bedrock 1.5 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Made ground	2.0	2.0
	Soil	0.2	2.2
Alluvium	Clay, laminated, medium dark grey; stoneless, firm, organic fragments common, sand lenses at base	0.9	3.1
Fluvio-glacial Sand and Gravel	Gravel Gravel: coarse and fine; Carboniferous limestone and sandstone, traces of Magnesian Limestone, chert, ironstone, Triassic sandstone and igneous rocks Sand: fine to coarse, subrounded lithic grains Fines: dark yellowish brown silt and clay	1.7	4.8
Till	Clay, moderate reddish brown; very sandy, stony, soft; clasts include Carboniferous limestone and sandstone; sand is subangular medium quartz	6.2	11.0
Sherwood Sandstone Group	Sandstone, moderate reddish brown, medium-grained	1.5+	12.5

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines		Sand			Gravel	
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
6	23	71	3.1-4.1	4	10	6	6	27	42	5
			4.1-4.8	7	9	5	8	40	31	0
			Mean	6	10	6	7	32	36	3

SE 37 NW 39 3461 7922 The Mask Block B

Surface level +31.7 m (+ 104 ft) Overburden 3.2 m
 Water struck at +28.5 m Mineral 2.7 m
 Shell and auger 200 mm Bedrock 0.1 m+
 October 1982

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Till	Clay, pale brown; sandy, sporadic pebbles of rounded Carboniferous sandstone and limestone	2.9	3.2
Glacial Sand and Gravel	Gravel Gravel: fine and coarse, some cobbles; rounded to well-rounded Carboniferous sandstone and limestone Sand: mainly medium, subrounded, quartz and limestone Fines: moderate reddish brown silt and clay	2.7	5.9
Sherwood Sandstone Group	Sandstone, moderate reddish brown	0.1+	6.0

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines		Sand			Gravel	
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
3	38	59	3.2-5.9	3	7	21	10	26	28	5

SE 37 NW 40 3006 7915 South-west of Duskhills Block B

Surface level +40.9 m (+134 ft) Overburden 0.2 m
 Water struck at +38.4 m Mineral 1.6 m
 Shell and auger 250 mm Waste 1.2 m
 September 1982 Bedrock 1.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Fluvio-glacial Terrace Deposits	Gravel Gravel: coarse and fine; angular to subrounded sandstone, with subrounded to rounded Carboniferous limestone and traces of Magnesian Limestone	1.6	1.8

Sand: medium and coarse, angular to subrounded
quartz with lithic grains
Fines: moderate yellowish brown

Till	Clay, pale yellowish brown; stony, firm; below 2.0 m, transition to olive grey, sandy, stony clay with pebbles, and cobbles of sandstone, Carboniferous limestone and Magnesian Limestone; with depth, Magnesian Limestone becomes the dominant clast type	1.2	3.0
Upper Magnesian Limestone	Limestone, dolomitic, pale yellowish brown	1.0+	4.0

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines			Sand		Gravel	
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
8	36	56	0.2-0.8	15	10	10	11	27	27	0
			0.8-1.8	4	6	16	17	25	26	6
			Mean	8	7	14	15	26	26	4

SE 37 NW 41 3061 7827 Howgrave Wood Block B

Surface level +36.7 m (+120 ft) Waste 1.5 m
 Water not struck Bedrock 2.0 m+
 Shell and auger 250 mm
 September 1982

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Fluvio-glacial Terrace Deposits	Gravel Gravel: coarse to cobble, angular to rounded; Carboniferous sandstone and limestone Sand: fine to medium, subrounded to rounded, quartz with lithic grains	0.3	0.5
Till	Clay, stony, moderate reddish brown; clasts include Magnesian Limestone	1.0	1.5
Upper Permian Marl	Clay, stoneless, moderate reddish brown	2.0+	3.5

SE 37 NW 42 3188 7841 Sutton Grange Block B

Surface level +45.8 m (+150 ft) Overburden 9.3 m
 Water struck at +40.8 m Mineral 5.2 m
 Shell and auger 250 mm Bedrock 1.2 m+
 October 1982

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Till	Clay, moderate reddish orange; stony, firm; sporadic pebbles of angular Carboniferous sandstone and limestone, and chert; pebbly bands occur sporadically below 7.2 m	9.1	9.3

Glacial Sand and Gravel	Gravel	5.2	14.5
	Gravel: mainly coarse with fine and cobbles; subrounded to rounded Carboniferous sandstone and rounded Carboniferous limestone, with some angular to subangular quartz and some Triassic sandstone Sand: mainly medium, angular to subangular, quartz and lithic grains		
Sherwood Sandstone Group	Sandstone, moderate reddish brown, fine-grained	1.2+	15.7

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
4	23	73	9.3-10.3	1	2	6	6	16	32	37
			10.3-11.3	2	4	14	10	18	44	8
			11.3-12.3	2	4	9	7	17	39	22
			12.3-13.3	4	6	16	8	19	29	18
			13.3-14.5	10	5	14	6	14	38	13
			Mean	4	4	12	7	17	37	19

SE 37 NW 43	3264 7852	Gallow Hill House	Block B
Surface level +39.5 m (+130 ft)			Waste 9.5 m
Water struck at +32.2 m			Bedrock 1.0 m+
Shell and auger 200 mm			
October 1982			

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Sandy Till	Clay, very sandy, moderate brown; clasts comprise subangular to rounded sandstone	0.8	1.0
	'Very clayey' sand Sand: mainly fine, subrounded to rounded, quartz with lithic grains Fines: light brown silt and clay; sporadic thin bands of moderate brown silt	1.0	2.0
Till	Clay, stony; moderate reddish brown, becoming moderate brown at 7.6 m; hard; clasts comprise pebbles and cobbles of angular to rounded Carboniferous limestone and sandstone, Magnesian Limestone and Triassic sandstone; sporadic thin bands of sand and gravel	7.5	9.5
Sherwood Sandstone Group	Sandstone, moderate reddish brown, fine-grained	1.0+	10.5

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
21	79	0	1.0-2.0	21	56	13	10	0	0	0

Surface level +37.5 m (+123 ft)
 Water struck at +29.3 m
 Shell and auger 200 mm
 October 1982

Overburden 7.0 m
 Mineral 1.8 m
 Waste 0.4 m
 Mineral 4.3 m
 Bedrock 0.8 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
Till	Clay, moderate yellowish brown to 0.6 m, light brown to 2.0 m, greyish red to 2.8 m, moderate brown to base; soft at first, becoming firm at base; sandy, stony; pebbles of sandstone, chert and Carboniferous limestone, with Triassic sandstone near base; sporadic thin bands of fine quartz sand	6.6	7.0
Glacial Sand and Gravel	<p>a Gravel Gravel: coarse with fine, subrounded to well-rounded Carboniferous limestone and subangular to rounded sandstone; Triassic sandstone more abundant with depth Sand: mainly medium, rounded, quartz and lithic grains Fines: moderate yellowish brown silt and clay</p> <p>Silt, clayey, dark yellowish brown, soft</p> <p>b Gravel Gravel: coarse with fine and cobbles; composition as deposit (a) Sand: mainly medium, rounded; quartz and lithic grains Fines: moderate yellowish brown</p> <p>c 'Clayey' pebbly sand Gravel: fine and coarse Sand: mainly fine, rounded; quartz and lithic grains</p>	1.8	8.8
		0.4	9.2
		3.0	12.2
		1.3	13.5
Sherwood Sandstone Group	Sandstone, moderate reddish brown; medium-grained	0.8+	14.3

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages							
	Fines	Sand	Gravel		Fines		Sand			Gravel		
					- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm	
a	5	17	78	7.0-8.0	1	3	10	2	26	57	1	
				8.0-8.8	10	3	10	7	27	43	0	
				Mean	5	3	10	4	26	51	1	
b	5	33	62	9.2-10.2	5	3	12	16	13	30	21	
				10.2-11.2	3	5	10	7	19	40	16	
				11.2-12.2	6	13	26	8	12	35	0	
				Mean	5	7	16	10	15	35	12	
c	11	82	7	12.2-13.5	11	46	25	11	5	2	0	
a+b+c	6	39	55	Mean	6	14	16	9	16	33	6	

Surface level c.+30.5 m (+100 ft)
 Water struck at +28.0 m
 Shell and auger 250 mm
 September 1982

Overburden 0.2 m
 Mineral 6.5 m
 Waste 0.8 m
 Mineral 13.0 m
 Waste 4.5 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
Alluvium	Clay, sandy, dark yellowish brown	0.2	0.2
River Terrace Deposits	a Gravel Gravel: fine and coarse, with cobbles; subangular to rounded sandstone with subrounded to rounded Carboniferous limestone and some angular Magnesian Limestone Sand: medium and coarse, angular to rounded, quartz and lithic grains Fines: dark yellowish brown silt and clay; thin band of silty clay at 5.8 m	6.5	6.7
Older Alluvium	Clay, olive grey, crudely laminated, with some fine-grained sand laminae, soft	0.8	7.5
Sand and Gravel of unknown age	b 'Clayey' sand (pebbly to 10.5 m) Sand: mainly medium and coarse at top, becoming mainly fine with depth; subangular to rounded, quartz with lithic grains and coal fragments Fines: moderate yellowish brown silt and clay	13.0	20.5
	Sand, clayey and silty; mainly fine quartz sand, with thin bands of soft, medium grey, silty clay	3.5	24.0
	Clay, medium dark grey; soft, laminated, sporadic pebbles of sandstone and Magnesian Limestone	1.0+	25.0

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
						-#	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64
a	5	29	66	0.2-1.2	10	6	13	11	23	33	4
				1.2-1.7	5	6	8	7	18	40	16
				1.7-2.7	0	2	7	11	20	39	21
				2.7-3.7	4	3	13	13	24	18	25
				3.7-4.7	4	4	14	12	35	30	1
				4.7-5.7	4	4	13	13	30	31	5
				5.7-6.7	9	13	16	10	30	20	2
				Mean	5	5	13	11	26	30	10
b	14	83	3	7.5-8.5	5	17	51	11	15	1	0
				8.5-9.5	4	14	39	34	8	1	0
				9.5-10.5	10	14	54	14	7	1	0
				10.5-11.5	8	36	47	5	4	0	0
				11.5-12.5	9	63	27	1	0	0	0
				12.5-13.5	7	56	35	2	0	0	0
				13.5-14.5	12	67	20	1	0	0	0
				14.5-16.5	13	74	12	1	0	0	0
				16.5-18.5	17	77	5	1	0	0	0
				18.5-20.5	36	60	4	0	0	0	0
				Mean	14	54	24	5	3	trace	0
a+b	11	66	23	20.5-22.5	43	55	1	1	0	0	0
				22.5-24.0	46	49	1	1	1	2	0
				Mean	44	53	1	1	trace	1	0
a+b	11	66	23	Mean	11	39	20	7	10	10	3

Surface level +37.3 m (+122 ft)
 Water struck at +29.3 m
 Shell and auger 250 mm
 October 1982

Waste 16.0 m
 Bedrock 1.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Fluvio-glacial Terrace Deposits	Clay, stony, very sandy, strong yellowish brown; pebbles of angular to rounded sandstone and rounded Carboniferous limestone	0.8	1.0
Till	Clay, sandy; moderate reddish brown, soft	2.0	3.0
	Clay, stony, sandy; greyish reddish brown; very hard; clasts comprise pebbles of limestone and sandstone	2.8	5.8
	Clay, stony, silty, brownish grey, firm; clasts as above	1.0	6.8
	Clay, stony, sandy, greyish reddish brown; very hard; 0.2 m band of pale reddish brown silty clay at 7.3-7.5 m; bands up to 0.8 m thick comprising coarse gravel and coarse sand, Carboniferous and Triassic lithologies dominant	8.2	15.0
	Clay, moderate reddish orange; hard, numerous small pebbles of marl with sandstone and Carboniferous limestone	1.0	16.0
Upper Permian Marl	Marl, moderate reddish orange, with very pale green patches	1.2+	17.2

Surface level +42.4 m (+139 ft)
 Water struck at +36.3 m
 Shell and auger 200 mm
 October 1982

Overburden 10.9 m
 Mineral 14.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Till	Clay, sandy; moderate yellowish brown; sporadic pebbles	0.2	0.4
	Clay, stony; initially light brown and very hard, but becoming dusky brown to dusky yellowish brown and hard with depth; pebbles and cobbles of Carboniferous and Triassic sandstone, Carboniferous limestone and Magnesian Limestone	10.5	10.9
Sand and Gravel of unknown age	Gravel Gravel: fine and coarse, with some cobbles, subangular to rounded sandstone, subrounded to rounded Carboniferous limestone, with some angular Triassic sandstone Sand: mainly medium, angular to rounded lithic grains and quartz Fines: light brown silt and clay; thin silt bands	14.1+	25.0

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines		Sand		Gravel		
				- $\frac{1}{8}$	+ $\frac{1}{8}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
3	23	74	10.9-11.9	3	3	8	8	29	45	4
			11.9-12.9	3	14	6	trace	30	57	2
			12.9-13.9	3	2	8	6	29	51	1
			13.9-14.9	1	2	5	8	24	46	14
			14.9-15.9	3	2	14	8	26	40	7
			15.9-16.9	3	7	16	8	40	26	0
			16.9-17.9	9	12	19	10	30	20	0
			17.9-18.9	2	7	16	6	28	38	3
			18.9-19.9	2	6	17	4	31	32	8
			19.9-20.9	4	4	8	7	36	36	5
			20.9-21.9	1	4	19	5	27	37	7
			21.9-22.9	1	2	9	5	36	47	0
			22.9-23.9	11	3	14	9	30	29	4
			23.9-25.0	3	4	10	7	41	32	3
			Mean	3	5	12	6	32	38	4

SE 37 NW 48 3316 7773 South of Middleton Quernhow Block B

Surface level +36.2 m (+119 ft) Waste 10.4 m
 Water struck at +33.6 m Bedrock 0.6 m+
 Shell and auger 200 mm
 October 1982

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.1	0.1
	Made ground (comprises aggregate in disused railway embankment)	2.5	2.6
Sandy Till	Clay, silty and sandy; light brown, hard	1.1	3.7
	Clay, stony; greyish reddish brown; clasts include pebbles and cobbles of Carboniferous limestone and sandstone	6.7	10.4
Sherwood Sandstone Group	Sandstone, dark reddish brown	0.6+	11.0

SE 37 NW 49 3464 7725 York Gate Farm Block B

Surface level +41.2 m (+135 ft) Waste 2.4 m
 Water not struck Bedrock 1.5 m+
 Shell and auger 200 mm
 October 1982

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.1	0.1
Sandy Till	Clay, sandy; light brown; friable	0.9	1.0
	'Very clayey' sand; mainly fine, subangular to rounded; quartz with some lithic grains; moderate reddish brown	1.3	2.3

	Clay, moderate reddish brown; firm, sporadic small clasts of marl	0.1	2.4
Sherwood Sandstone Group	Sandstone, moderate reddish brown	1.5+	3.9

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16} - \frac{1}{4}$	$+\frac{1}{4} - 1$	$+1 - 4$	$+4 - 16$	$+16 - 64$	$+64$ mm
26	74	0	1.0-2.3	26	67	6	1	trace	0	0

SE 37 NW 50	3003 7642	North Parks Farm, Ripon Parks	Block A
Surface level +33.5 m (+110 ft)			Overburden 0.4 m
Water struck at +28.5 m			Mineral 2.9 m
Shell and auger 250 mm			Waste 1.7 m
November 1982			Mineral 10.8 m
			Waste 2.8 m
			Mineral 2.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
Fluvio-glacial Terrace Deposits	a Gravel Gravel: fine and coarse; subangular to rounded Carboniferous sandstone and limestone, with some quartzite and chert Sand: medium and coarse, subrounded to subangular; lithic grains with quartz Fines: pale yellowish brown silt and clay	2.9	3.3
Till	Clay, silty, slightly sandy, very stony; greyish brown, firm to hard; clasts comprise subrounded to subangular granules and pebbles with sporadic cobbles; Carboniferous limestone and sandstone	1.7	5.0
Sand and Gravel of unknown age	b Gravel Gravel: fine and coarse, with some cobble; subrounded Carboniferous limestone and sandstone, trace of Triassic sandstone Sand: medium and coarse, lithic grains with quartz Fines: pale yellowish brown silt and clay	10.8	15.8
	Clay, silty, stony, greyish brown to 17.8 m; greyish red below, soft; clasts comprise abundant angular granules of Carboniferous limestone and sandstone, with chert; sporadic pebbles and cobbles of these lithologies	2.8	18.6
	c Gravel Gravel: fine and coarse, subrounded Carboniferous sandstone and rounded Carboniferous limestone Sand; mainly coarse, lithic grains Fines: pale yellowish brown silt and clay	2.1+	20.7

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines		Sand		Gravel		
					- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ - 1	+1 - 4	+4 - 16	+16 - 64	+64 mm
a	5	35	60	0.4-1.5	8	6	18	14	26	24	4
				1.5-2.6	2	3	14	13	27	41	0
				2.6-3.3	5	7	15	14	21	36	2
				Mean	5	5	16	14	26	32	2
b	5	28	67	5.0-6.3	2	1	11	14	26	43	3
				6.3-7.3	4	3	16	14	31	31	1
				7.3-8.3	2	1	4	7	25	56	5
				8.3-9.3	1	4	13	11	30	37	4
				9.3-10.3	1	1	8	10	34	45	1
				10.3-11.3	2	3	24	11	34	26	0
				11.3-12.3	2	4	24	13	37	20	0
				12.3-15.8	12	2	16	10	33	27	0
				Mean	5	2	15	11	32	34	1
c	7	44	49	18.6-19.7	7	7	11	11	22	35	7
				19.7-20.7	8	9	19	31	19	14	0
				Mean	7	8	15	21	20	25	4
a+b+c	5	31	64	Mean	5	3	15	13	29	33	2

SE 37 NW 51	3171 7607	South Lawn, Norton Conyers	Block A
Surface level +30.1 m (+99 ft)			Overburden 1.7 m
Water struck at +26.1 m			Mineral 2.4 m
Shell and auger 250 mm			Waste 9.9 m
November 1982			Bedrock 4.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
River Terrace Deposits	Silt, clayey and slightly sandy, very soft, stoneless, laminated, light brown	1.5	1.7
	Gravel Gravel: coarse and fine, with cobbles; rounded Carboniferous limestone and sandstone, with Palaeozoic siltstone and angular chert Sand: mainly coarse, subangular to subrounded quartz and lithic grains Fines: moderate brown silt and clay	2.4	4.1
Till	Clay, greyish brown; silty, very stony, with sporadic cobbles and boulders, firm; clasts include rounded pebbles of Carboniferous sandstone and limestone and many granules of Triassic sandstone	8.9	13.0
Laminated Clay	Clay and silt, interlaminated; stoneless, firm; dusky yellowish brown clay with very pale orange silt; disturbed	0.1	13.1
	Clayey gravel, mainly coarse; subrounded Carboniferous limestone and sandstone with angular cobbles of Magnesian Limestone; mainly coarse sand; pale yellowish brown fines	0.9	14.0
Upper Magnesian Limestone	Limestone, grey; dolomitic, hard	4.0+	18.0

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines			Sand		Gravel	
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
2	14	84	1.7-2.0	8	7	9	10	30	36	0
			2.0-3.0	1	2	3	7	24	37	26
			3.0-4.0	0	1	3	8	20	53	15
			4.0-4.1	1	1	6	13	32	46	1
			Mean	2	2	4	8	23	44	17

SE 37 NW 52 3202 7680 North Lawn, Norton Conyers Block B

Surface level +31.7 m (+104 ft) Overburden 1.5 m
 Water struck at +30.1 m Mineral 4.9 m
 Shell and auger 250 mm Waste 1.2 m
 November 1982 Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Fluvio-glacial Terrace Deposits	Clay, very sandy and silty; very stony, with some boulders	1.3	1.5
	Pebbly sand (gravel at top) Gravel: fine and coarse, rounded Carboniferous limestone, with Carboniferous sandstone and some chert, trace of igneous rocks Sand: mainly fine, quartz and lithic grains Fines: moderate brown silt and clay	4.9	6.4
Till	Clay, silty, very stony, with abundant granules; greyish reddish brown, very hard, clasts include rounded Carboniferous sandstone, Permo-Triassic sandstone and siltstone, angular chert	1.0	7.4
	Clay, stoneless, hard, moderate reddish brown; includes much bedrock	0.2	7.6
Upper Permian Marl	Mudstone, fissile, hard, moderate reddish brown	0.2+	7.8

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines			Sand		Gravel	
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
3	78	19	1.5-2.5	1	13	3	12	38	30	3
			2.5-5.5	3	82	10	3	0	2	0
			5.5-6.4	No grading data available						
			Mean	3	65	8	5	9	9	1

SE 37 NW 53 3328 7644 Melmerby Green End

Block B

Surface level +37.3 m (+122 ft)
 Water not struck
 Shell and auger 200 mm
 October 1982

Waste 10.2 m
 Bedrock 0.8 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Sandy Till	Clay, very sandy, light brown, hard	0.8	1.0
	'Clayey' sand: fine, angular to subrounded, equant quartz with lithic grains; moderate brown fines	0.1	1.1
	Clay, stony, moderate brown, firm; clasts include pebbles of Carboniferous sandstone and limestone, with Magnesian Limestone	0.1	1.2
	Clay, very sandy, stony; light brown, soft; clasts as above; sporadic bands (up to 0.3 m thick) of fine-grained sand	1.3	2.5
Till	Clay, stony; greyish red, hard; pebbles and cobbles of Carboniferous sandstone and limestone	7.7	10.2
Sherwood Sandstone Group	Sandstone, moderate reddish brown, fine-grained	0.8+	11.0

SE 37 NW 54 3456 7640 Underlands Lane, Melmerby

Block B

Surface level +48.5 m (+159 ft)
 Water not struck
 Shell and auger 200 mm
 October 1982

Waste 2.0 m
 Bedrock 1.8 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Sandy Till	Clay, sandy, stony; moderate brown, firm; sporadic pebbles of Carboniferous limestone and sandstone; bands (up to 0.3 m thick) of fine-grained 'very clayey' sand	1.7	2.0
Sherwood Sandstone Group	Sandstone, moderate reddish brown; fine-grained, weathered to 2.8 m	1.8+	3.8

Surface level +19.5 m (+64 ft)
 Water struck but level not recorded
 Shell and auger 250 mm
 October 1982

Overburden 0.7 m
 Mineral 6.5 m
 Waste 9.8 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.7	0.7
	a Gravel	3.9	4.6
	Gravel: fine and coarse, with cobbles; rounded Carboniferous limestone and sandstone, with chert		
	Sand: medium and coarse, subangular; quartz and lithic grains		
	Fines: greyish brown silt and clay		
	b Sandy gravel	2.6	7.2
	Gravel: fine and coarse, with some cobbles; Carboniferous sandstone and limestone, with some chert		
	Sand: mainly medium; subrounded quartz, with rounded lithic grains		
	Fines: greyish brown silt and clay		
Sand and Gravel of unknown age	Clay and silt, interlaminated; brownish grey, stoneless, soft, sporadic organic fragments; clayey silt band at 9.4-10.0 m	7.8	15.0
Till	Clay, brownish grey; silty and stony, firm, clasts comprise Carboniferous limestone and sandstone with Triassic sandstone	2.0+	17.0

Borehole abandoned due to operational difficulties

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines		Sand		Gravel		
					-1/16	+1/16 - 1/4	+1/4 - 1	+1 - 4	+4 - 16	+16 - 64	+64 mm
a	4	27	69	0.7-1.7	8	9	20	10	24	27	2
				1.7-2.5	5	5	15	10	26	35	4
				2.5-3.5	1	1	7	11	32	40	8
				3.5-4.6	3	2	7	13	26	43	6
				Mean	4	4	12	11	27	37	5
b	5	63	32	4.6-5.5	3	8	48	6	13	22	0
				5.5-6.5	5	5	63	13	7	7	0
				6.5-7.2	7	7	24	9	22	31	0
				Mean	5	7	46	10	13	19	0
a+b	5	41	54	Mean	5	5	26	10	21	30	3

Surface level +27.7 m (+91 ft)
 Water struck but level not recorded
 Shell and auger 200 mm
 October 1982

Overburden 0.5 m
 Mineral 4.2 m
 Waste 2.4 m
 Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
River Terrace Deposits	Clay, silty, brown	0.2	0.5
	Gravel Gravel: fine and coarse, subrounded to well- rounded Carboniferous limestone and sandstone, with subrounded chert Sand: mainly coarse, angular to subrounded; quartz with lithic grains	4.2	4.7
Till	Clay, stony, pebbles and cobbles of Carboniferous sandstone and limestone	2.4	7.1
Middle Permian Marl	Mudstone, reddish brown, with green mottling	0.2+	7.3

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines		Sand		Gravel		
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
2	26	72	0.5-1.2	4	4	15	17	38	22	0
			1.2-2.2	1	3	8	11	39	32	6
			2.2-3.2	2	3	10	19	35	29	2
			3.2-4.7	2	2	3	14	37	41	1
			Mean	2	3	8	15	38	32	2

Surface level +30.5 m (+100 ft)
 Water struck at +29.8 m
 Shell and auger 200 mm
 October 1982

Waste 7.5 m
 Bedrock 1.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Made ground	0.7	0.7
Glacial Lake Deposits	Clay, olive grey, soft; some fragments of organic matter	0.2	0.9
	Clay, mottled light olive grey and light olive brown, soft; some fragments of organic matter	0.4	1.3
Till	Clay, stony; moderate reddish brown, soft; clasts comprise pebbles of Carboniferous sandstone, and pebbles and cobbles of Carboniferous limestone	6.2	7.5
Sherwood Sandstone Group	Sandstone, moderate reddish brown, fine-grained	1.0+	8.5

Surface level +20.9 m (+69 ft)
 Water struck at +18.7 m
 Shell and auger 200 mm
 October 1982

Overburden 2.7 m
 Mineral 3.8 m
 Bedrock 1.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.1	0.1
Alluvium	Clay, yellowish orange; sandy	1.3	1.4
	Silt, medium grey; sandy, clayey	1.3	2.7
	a 'Clayey' sand: mainly fine, angular to subangular; quartz with some limestone	1.6	4.3
	b Gravel Gravel: coarse, with fine, well-rounded Carboniferous limestone with rounded to subrounded Carboniferous sandstone, some chert and Triassic sandstone Sand: mainly fine, angular; quartz with limestone Fines: moderate reddish brown silt and clay	2.2	6.5
Sherwood Sandstone Group	Sandstone, moderate reddish brown	1.0+	7.5

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines		Sand		Gravel		
					- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
a	16	84	0	2.7-4.3	16	60	23	1	0	0	0
b	7	22	71	4.3-6.5	7	16	3	3	21	48	2
a+b	11	48	41	Mean	11	35	11	2	12	28	1

Surface level +29.6 m (+97 ft)
 Water not recorded
 Shell and auger 200 mm
 September 1982

Overburden 0.8 m
 Mineral 9.5 m
 Waste 3.2 m
 Mineral 5.5 m
 Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.8	0.8
Glacial Sand and Gravel	a 'Very clayey' sand Sand: mainly fine, subrounded; quartz Fines: moderate reddish brown silt and clay	9.5	10.3
	Silt, moderate reddish brown; rare clay bands	3.2	13.5
	b 'Clayey' sand Sand: fine, angular to subrounded; quartz Fines: moderate reddish brown silt and clay	5.5	19.0
Sherwood Sandstone Group	Sandstone, weathered, moderate reddish brown	0.1+	19.1

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
						- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64
a	23	77	0	0.8-2.8	38	60	1	1	0	0	0
				2.8-5.5	5	87	8	0	0	0	0
				5.5-6.6	13	85	2	0	0	0	0
				6.6-8.3	37	61	1	1	0	0	0
				8.3-10.3	25	73	1	1	0	0	0
				Mean	23	74	3	trace	0	0	0
b	10	90	0	13.5-16.1	13	84	2	1	0	0	0
				16.1-19.0	7	87	5	1	0	0	0
				Mean	10	86	3	1	0	0	0
a+b	18	82	0	Mean	18	78	3	1	0	0	0

SE 37 NE 35 3854 7967 Leys

Block C

Surface level +29.3 m (+96 ft)
 Water struck but level not recorded
 Shell and auger 200 mm
 October 1982

Overburden 0.5 m
 Mineral 4.0 m
 Waste 1.0 m
 Mineral 16.2 m
 Waste 1.1 m
 Mineral 1.6 m
 Waste 0.1 m
 Bedrock 0.9 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.5	0.5
Glacial Sand and Gravel	a 'Very clayey' sand Sand: fine, subangular to rounded; quartz with some lithic grains Fines: moderate reddish brown silt and clay; sporadic thin bands of greyish brown laminated clay	4.0	4.5
	Clay, very sandy; moderate reddish brown, soft	1.0	5.5
	b 'Clayey' sand Sand: fine, subangular to rounded; quartz with lithic grains Fines: moderate reddish brown silt and clay; sporadic thin bands of laminated clay	16.2	21.7
	Clay and sand in thin alternating bands	1.1	22.8
	c 'Clayey' sand Sand: fine, subangular to rounded, quartz with lithic grains Fines: moderate reddish brown silt and clay	1.6	24.4
	Clay, pale reddish brown, soft	0.1	24.5
Sherwood Sandstone Group	Sandstone, greyish red, fine-grained, weathered, soft, friable	0.9+	25.4

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
						+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
a	26	74	0	0.5-1.5	21	76	2	1	0	0	0
				1.5-2.5	38	60	1	1	0	0	0
				2.5-3.5	25	73	1	1	0	0	0
				3.5-4.5	20	79	1	0	0	0	0
				Mean	26	72	1	1	0	0	0
	46	54	0	4.5-5.5	46	49	4	1	0	0	0
b	11	89	0	5.5-6.5	30	68	1	1	0	0	0
				6.5-7.5	23	75	1	1	0	0	0
				7.5-8.5	6	58	35	1	0	0	0
				8.5-9.5	8	41	49	2	0	0	0
				9.5-10.5	8	28	63	1	0	0	0
				10.5-11.5	9	60	30	1	0	0	0
				11.5-12.5	8	77	14	1	0	0	0
				12.5-13.5	7	89	4	0	0	0	0
				13.5-14.5	6	90	3	1	0	0	0
				14.5-15.5	7	91	2	0	0	0	0
				15.5-16.5	8	89	3	0	0	0	0
				16.5-17.5	7	90	3	0	0	0	0
				17.5-18.5	10	87	3	0	0	0	0
				18.5-19.5	7	87	5	1	0	0	0
				19.5-20.5	12	85	2	1	0	0	0
20.5-21.7	14	83	2	1	0	0	0				
Mean	11	74	14	1	0	0	0				
c	16	84	0	22.8-24.4	16	83	1	trace	0	0	0
a+b+c	14	86	0	Mean	14	75	10	1	0	0	0

SE 37 NE 36

3510 7878

Baldersby

Block B

Surface level +30.7 m (+101 ft)
 Water struck at +25.7 m
 Shell and auger 200 mm
 October 1982

Overburden 5.2 m
 Mineral 2.8 m
 Bedrock 1.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Made ground	0.2	0.2
Till	Clay, yellowish brown, sandy, stony	1.8	2.0
	Clay, dusky brown, silty, stony; pebbles of rounded Carboniferous sandstone	3.2	5.2
Glacial Sand and Gravel	Gravel Gravel: fine and coarse, rounded Carboniferous sandstone and limestone, traces of Magnesian Limestone and Triassic sandstone Sand: mainly fine, subangular to subrounded; quartz with traces of limestone; clay parting from 5.7 to 5.9 m	2.8	8.0
Sherwood Sandstone Group	Sandstone, moderate reddish brown, weathered; thin bands of moderate reddish brown marl with green spots	1.1+	9.1

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines		Sand		Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16} - \frac{1}{4}$	$+\frac{1}{4} - 1$	$+1 - 4$	$+4 - 16$	$+16 - 64$	$+64$ mm
4	18	78	5.2-6.2	10	12	6	6	36	30	0
			6.2-8.0	2	5	6	5	26	51	5
			Mean	4	7	6	5	30	45	3

SE 37 NE 37 3599 7824 Marlpit Lane, Baldersby Block B

Surface level +29.2 m (+96 ft) Waste 2.4 m
 Water not struck Bedrock 0.8 m+
 Shell and auger 200 mm
 October 1982

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
Glacial Lake Deposits	Clay, sandy, yellowish brown	1.5	1.9
	Clay, laminated, greyish brown	0.5	2.4
Sherwood Sandstone Group	Sandstone, reddish brown, weathered; broken fragments in a sandy matrix	0.8+	3.2

SE 37 NE 38 3819 7870 Sugar Hill Block C

Surface level +25.7 m (+84 ft) Waste 13.8 m
 Water not recorded Bedrock 4.1 m+
 Shell and auger 200 mm
 November 1982

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Glacial Lake Deposits	Clay, stoneless, laminated; moderate brown, soft	11.0	11.3
	Till	2.5	13.8
Sherwood Sandstone Group	Sandstone, red, medium-grained, very hard; weathered to 16.4 m	4.1+	17.9

Surface level +24.0 m (+79 ft)
 Water struck but level not recorded
 Shell and auger 200 mm
 October 1982

Overburden 0.3 m
 Mineral 1.0 m
 Waste 18.7 m
 Bedrock 1.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Glacial Lake Deposits	'Clayey' sand Sand: mainly fine, subangular to rounded, quartz with some lithic grains Fines: dark yellowish orange silt and clay	1.0	1.3
	Clay, medium dark grey, becoming brownish grey below 13.0 m; laminated, rare ?dropstones, soft, sporadic thin bands of sand throughout	12.9	14.2
Till	Clay, moderate reddish brown, sandy in part, stony, firm	0.3	14.5
Laminated Clay closely associated with Glacial Deposits	Clay, as 1.3-14.2 m	3.9	18.4
Glacial Sand and Gravel	Sand: fine, subrounded to rounded; quartz with some lithic grains, moderate reddish brown	0.7	19.1
	Clay, as 14.5-18.4	0.1	19.2
	Gravel Gravel: fine, subangular to subrounded; Triassic sandstone, Carboniferous sandstone and limestone, quartzite, with angular chert and rounded Magnesian Limestone Sand: fine, subrounded to rounded, quartz with some lithic grains, moderate reddish brown	0.8	20.0
Sherwood Sandstone Group	Sandstone, moderate reddish brown, fine-grained	1.0+	21.0

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
11	89	0	0.3-1.3	11	57	31	1	0	0	0

Surface level c.+38.0 m (+125 ft)
 Water not struck
 Shell and auger 200 mm
 October 1982

Overburden 3.2 m
 Mineral 1.3 m
 Bedrock 1.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Till	Clay, moderate brown, stony; clasts comprise rounded limestone and sandstone pebbles	2.9	3.2
Glacial Sand and Gravel	Gravel Gravel: fine and coarse, rounded Carboniferous limestone and sandstone Sand: mainly fine, angular, quartz, with some limestone Fines: moderate reddish brown silt and clay	1.3	4.5
Sherwood Sandstone Group	Sandstone, reddish brown, weathered	1.0+	5.5

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
6	27	67	3.2-4.5	6	16	2	9	41	25	1

Surface level +31.7 m (+104 ft)
 Water not struck
 Shell and auger 200 mm
 October 1982

Waste 5.5 m
 Bedrock 1.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Sandy Till	Sand, very clayey, stony; moderate reddish brown, soft; clasts include Carboniferous lithologies up to cobble size	5.2	5.5
Sherwood Sandstone Group	Sandstone, dark reddish brown, weathered	1.0+	6.5

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
31	36	33	0.3-1.2	35	43	6	3	5	8	0
			1.2-3.2	33	22	5	4	17	19	0
			3.2-5.5	27	27	5	3	15	21	2
			Mean	31	28	5	3	14	18	1

SE 37 NE 43 3865 7791 Park Barn

Block C

Surface level +20.1 m (+66 ft)
 Water struck but level not recorded
 Shell and auger 200 mm
 September, 1982

Overburden 8.7 m
 Mineral 4.4 m
 Bedrock 0.5 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Glacial Lake Deposits	Clay, greyish brown, laminated; rare Carboniferous sandstone pebbles (?dropstones); passing into ?till at base	8.5	8.7
Glacial Sand and Gravel	'Clayey' sand Sand: fine, quartz Fines: moderate reddish brown silt and clay	4.4	13.1
Sherwood Sandstone Group	Sandstone, moderate reddish brown, soft, weathered	0.5+	13.6

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- $\frac{1}{16}$	$+\frac{1}{16}$ - $\frac{1}{4}$	$+\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
18	82	0	8.7-13.1	18	78	3	1	0	0	0

SE 37 NE 44 3959 7794 East Lodge

Block E

Surface level +25.8 m (+85 ft)
 Water struck but level not recorded
 Shell and auger 200 mm and 150 mm
 September 1982

Waste 16.6 m
 Bedrock 0.5 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Glacial Lake Deposits	Clay, laminated, greyish brown; sporadic small pebbles (dropstones?) occur below 9.1 m; sand laminae alternate with clay laminae below 10.1 m	16.3	16.6
Sherwood Sandstone Group	Sandstone, red	0.5+	17.1

SE 37 NE 45 3850 7621 Baldersby Park

Block C

Surface level +30.5 m (+100 ft)
 Water not struck
 Shell and auger 200 mm
 September 1982

Overburden 0.4 m
 Mineral 8.7 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
Glacial Sand and Gravel	'Clayey' sand Sand: mainly fine, angular quartz with rounded limestone Fines: moderate reddish brown; pebbly at base	8.7+	9.1

Borehole abandoned due to operational difficulties

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines		Sand		Gravel		
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ - 1	+1 - 4	+4 - 16	+16 - 64	+64 mm
11	86	3	0.4-1.6	26	72	1	1	0	0	0
			1.6-2.6	12	85	2	1	0	0	0
			2.6-3.6	7	91	1	1	0	0	0
			3.6-4.6	9	44	46	1	0	0	0
			4.6-6.1	7	24	61	5	1	2	0
			6.1-9.1	9	43	34	6	5	3	0
			Mean	11	55	28	3	2	1	0

SE 37 NE 46 3928 7644 East of Salmon Hall

Block C

Surface level +19.8 m(+65 ft)
 Water struck at +15.7 m
 Shell and auger 200 mm
 September 1982

Overburden 0.2 m
 Mineral 1.6 m
 Waste 2.3 m
 Mineral 0.9 m
 Waste 3.8 m
 Mineral 1.7 m
 Waste 1.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Alluvium	a 'Clayey' sand, fine	1.6	1.8
	Silt, grey, soft	1.2	3.0
	Clay, greyish brown interlaminated with grey silt	1.1	4.1
	b Sandy gravel	0.9	5.0
	Gravel: fine and coarse, sandstone and limestone, with some Magnesian Limestone Sand: mainly medium, quartz and lithic grains		
Laminated Clay closely associated with Glacial Deposits	Clay, greyish, brown, laminated, soft; rare pebbles	3.8	8.8

Glacial Sand and Gravel	c Gravel Gravel: fine and coarse, rounded; Carboniferous sandstone with some Carboniferous limestone and a trace of Triassic sandstone	1.7	10.5
Till	Clay, moderate reddish brown; sandy, stony; clasts of Triassic sandstone and Carboniferous sandstone	1.0+	11.5
Borehole abandoned due to ingress of rising sand at 11.5 m			

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines			Gravel			
					- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ - 1	+1 - 4	+4 - 16	+16 - 64	+64 mm
a	18	82	0	0.2-1.8	18	69	12	1	0	0	0
b	4	71	25	4.1-5.0	4	14	42	15	17	8	0
c	4	36	60	8.8-9.8	3	14	6	11	35	25	6
				9.8-10.5	4	22	8	11	20	33	2
			Mean		4	18	7	11	28	28	4
a+b	13	78	9	Mean	13	49	23	6	6	3	0
a+b+c	9	61	30	Mean	9	37	16	8	15	13	2

SE 37 NE 47	3974 7698	Providence Hill	Block C
Surface level +29.3 m (+96 ft)			Overburden 8.0 m
Water not struck			Mineral 3.5 m
Shell and auger 200 mm			Waste 3.5 m
September 1982			Mineral 2.0 m
			Waste 1.0 m
			Bedrock 0.5 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Till	Clay, moderate brown, stony; pebbles of Carboniferous sandstone and limestone	2.5	2.7
Glacial Sand and Gravel	Clayey sand, pale reddish brown; fine quartz; some clay bands	1.4	4.1
	Clay, moderate reddish brown; silty	2.1	6.2
	Clay, moderate brown; laminated	1.0	7.2
	Silt, moderate reddish brown; clay bands	0.8	8.0
	a 'Very clayey' sand, mainly fine	3.5	11.5
	Silt, sandy, moderate reddish brown	3.5	15.0
	b 'Clayey' pebbly sand, Gravel: fine, rounded Carboniferous sandstone and limestone, trace of Triassic sandstone Sand: mainly fine, angular, quartz, with some limestone	2.0	17.0
Till	Clay, moderate reddish brown; soft; rounded pebbles of red sandstone	1.0	18.0
Sherwood Sandstone Group	Sandstone, moderate reddish brown; recovered as fragments	0.5+	18.5

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines			Sand		Gravel	
					- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
	a	29	71		0	8.0-11.5	29	67	3	1	0
b	15	70	15	15.0-17.0	15	41	18	11	11	4	0
a+b	24	70	6	Mean	24	58	8	4	4	2	0

SE 37 NE 48 3631 7562 New Road, Rainton Block B

Surface level +44.0 m (+144 ft) Waste 2.3 m
 Water not struck Bedrock 0.1 m+
 Shell and auger 200 mm
 October 1982

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Till	Clay, sandy, dusky brown; becoming pale brown below 1.3 m with sporadic pebbles of Carboniferous lithologies	2.0	2.3
Sherwood Sandstone Group	Sandstone, moderate reddish brown, weathered	0.1+	2.4

SE 37 NE 49 3726 7598 Rainton Block B

Surface level +30.0 m (+98 ft) Waste 5.0 m
 Water struck at +28.4 m Bedrock 1.0 m+
 Shell and auger 200 mm
 September 1982

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Sandy Till	Clay, very sandy; pale yellowish brown, mottled with light brown and dark yellowish orange; sporadic sandstone pebbles, with cobbles below 1.5 m, soft; crudely laminated between 1.0 m and 1.4 m	2.5	2.8
	Clay, sandy, stony, dark yellowish brown; soft, becoming hard below 4.0 m, clasts comprise sandstone pebbles and cobbles	2.2	5.0
Sherwood Sandstone Group	Sandstone, medium- to coarse-grained, moderate reddish brown	1.0+	6.0

Surface level +34.3 m (+113 ft)
 Water struck at +27.3 m
 Shell and auger 200 mm
 September 1982

Overburden 0.3 m
 Mineral 6.8 m
 Waste 1.4 m
 Mineral 8.5 m
 Waste 3.0 m
 Mineral 2.0 m
 Bedrock 1.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Glacial Sand and Gravel	a 'Very clayey' sand Sand: fine, rounded; quartz with some lithic grains Fines: light brown silt and clay; thin band of crudely laminated dark yellowish brown clay at 2.5 m	6.8	7.1
Laminated Clay closely associated with Glacial Deposits	Clay, silty and sandy, crudely laminated moderate reddish brown; some thin bands of quartz sand	1.4	8.5
Glacial Sand and Gravel	b 'Clayey' sand Sand: fine, rounded, quartz with some lithic grains (including coal) Fines: moderate brown silt and clay	8.5	17.0
Till	Clay, medium dark grey; initially laminated, then stony, soft, becoming hard	3.0	20.0
Glacial Sand and Gravel	c Gravel Gravel: fine and coarse, rounded sandstone, with subrounded Carboniferous limestone with some subrounded quartz and angular ironstone Sand: medium and coarse, subrounded to rounded quartz and lithic grains Fines: greyish orange silt and clay	2.0	22.0
Sherwood Sandstone Group	Sandstone, moderate reddish brown	1.0+	23.0

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
						- $\frac{1}{16}$	$+\frac{1}{16}$ - $\frac{1}{4}$	$+\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64
a	28	72	0	0.3-1.3	33	61	3	3	0	0	0
				1.3-2.1	20	79	1	0	0	0	0
				2.1-3.1	50	49	1	0	0	0	0
				3.1-4.0	10	89	1	0	0	0	0
				4.0-5.0	35	64	1	0	0	0	0
				5.0-6.0	11	88	1	0	0	0	0
				6.0-7.1	31	69	0	0	0	0	0
				Mean	28	70	1	1	0	0	0
b	13	87	0	8.5-10.5	14	79	6	1	0	0	0
				10.5-13.8	8	91	1	0	0	0	0
				13.8-15.8	18	80	1	1	0	0	0
				15.8-17.0	19	79	1	1	0	0	0
				Mean	13	85	2	trace	0	0	0
c	2	37	61	20.0-21.0	3	7	16	10	23	39	2
				21.0-22.0	1	7	21	12	24	34	1
				Mean	2	7	19	11	24	36	1
a+b	20	80	0	Mean	20	77	2	1	0	0	0
a+b+c	17	76	7	Mean	17	70	4	2	3	4	trace

SE 37 NE 51 3950 7579 North Fields

Block D

Surface level +26.5 m (+87 ft)
 Water not struck
 Shell and auger 200 mm
 December 1982

Overburden 8.0 m
 Mineral 5.4 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Till	Clay, sandy, stony, pale brown	2.9	3.2
Laminated Clay closely associated with Glacial Deposits	Clay, dusky brown	3.3	6.5
Glacial Sand and Gravel	Clayey sand, moderate reddish brown, with clay bands	1.5	8.0
	Gravel Gravel: fine and coarse; rounded to well-rounded, Carboniferous sandstone and limestone with some Triassic sandstone and traces of chert, mudstone, igneous rocks and quartz Sand: fine and coarse, quartz	5.4+	13.4

Borehole abandoned due to operational difficulties

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines		Sand		Gravel		
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
4	17	79	8.0-10.0	3	5	2	6	28	54	2
			10.0-12.0	4	10	3	8	51	24	0
			12.0-13.4	5	11	3	3	17	61	0
			Mean	4	8	3	6	34	44	1

SE 37 NE 52 3773 7772 Caldron Lane, Catton

Block C

Surface level +29.3 m (+96 ft)
 Water struck at +16.4 m
 Shell and auger 200 mm
 December 1982

Overburden 0.3 m
 Mineral 6.0 m
 Waste 0.7 m
 Mineral 8.1 m
 Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Glacial Sand and Gravel	a 'Clayey' sand Sand: fine, subangular, quartz Fines: pale reddish brown silt and clay	6.0	6.3
	Silt, pale brown, clay partings	0.7	7.0

b 'Very clayey' sand	5.9	12.9
Sand: fine, angular to subrounded; quartz		
Fines: moderate reddish brown silt and clay		
c Gravel	2.2	15.1
Gravel: coarse and fine with cobbles, rounded;		
Carboniferous sandstone with Carboniferous limestone,		
trace of Magnesian Limestone		
Sand: mainly fine, subangular, quartz		
Fines: pale brown silt and clay		

Sherwood Sandstone Group Sandstone, moderate reddish brown 0.2+ 15.3

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages							
	Fines	Sand	Gravel		Fines		Sand			Gravel		
					- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1-4	+4-16	+16-64	+64 mm	
	a	15	85		0	0.3-6.3	15	85	trace	trace	0	0
b	23	77	0	7.0-12.9	23	77	trace	trace	0	0	0	
c	4	16	80	12.9-13.9	2	6	1	6	29	44	12	
				13.9-15.1	5	14	3	3	14	50	11	
				Mean	4	10	2	4	21	48	11	
a+b	19	81	0	Mean	19	81	trace	trace	0	0	0	
b+c	18	60	22	Mean	18	58	1	1	6	13	3	
a+b+c	17	71	12	Mean	17	69	1	1	3	7	2	

SE 37 SW E1 3056 7045 Gravel Pit, Borrage Green, Ripon Block A
 Surface level c.+38 m (+125 ft) Mineral 7.0 m+
 Water not struck
 Sampled by hand from exposure
 February 1983

LOG

Geological classification	Lithology	Thickness m	Depth m
Fluvio-glacial Terrace Deposits	a 'Clayey' gravel Gravel: mainly coarse, rounded; Magnesian Limestone, Carboniferous limestone and sandstone, traces of chert and ironstone Sand: medium and coarse, rounded to subangular, lithic grains with quartz; crudely stratified; sand occurs as matrix and in discrete lenses up to 20 cms thick	3.0	3.0
	b Sand, medium, rounded to subangular; lithic grains and quartz; cross-bedded with distinct undulating surfaces	1.0	4.0
	c Gravel (sand between 5.5 and 6.0 m) Gravel: coarse and fine, rounded; Magnesian Limestone, Carboniferous limestone and sandstone, with some chert Sand: mainly medium, rounded to subangular, lithic grains and quartz; crudely stratified with sand bands and lenses; locally oxidized/reduced with orange/black bands	3.0+	7.0
Base not exposed			

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages									
	Fines	Sand	Gravel		Fines			Sand				Gravel		
					-1/16	+1/16 - 1/4	+1/4 - 1	+1 - 4	+4 - 16	+16 - 64	+64 mm			
a	11	17	72	0.0-3.0	11	2	8	7	18	41	13			
b	4	96	0	3.0-4.0	4	47	48	1	0	0	0			
c	3	44	53	4.0-5.5	6	3	18	10	25	32	6			
				5.5-6.0	2	4	91	3	0	0	0			
				6.0-7.0	1	1	19	14	19	37	9			
				Mean	3	3	31	10	19	28	6			
a+b+c	7	41	52	Mean	7	9	24	8	16	28	8			

SE 37 SW 99 3043 7455 Queen Mary's Dubb, Ripon Parks Block A

Surface level +45.2 m (+148 ft) Waste 7.3 m
 Water struck at +37.9 m Bedrock 0.5 m+
 Shell and auger 200 mm
 November 1982

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Till	Clay, sandy, stony; moderate reddish brown, becoming greyish brown between 4.5-6.1 m; clasts include Carboniferous limestone and sandstone, with angular marl fragments below 6.1 m	7.0	7.3
Middle Permian Marl	Mudstone, greenish grey, hard; veins of gypsum	0.5+	7.8

SE 37 SW 100 3160 7488 Hall Garth Hill Block A

Surface level +24.5 m (+80 ft) Overburden 2.2 m
 Water struck at +22.3 m Mineral 12.0 m
 Shell and auger 200 mm Waste 0.2 m
 October 1982 Bedrock 1.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
River Terrace Deposits and Sand and Gravel of unknown age	Clay, sandy, stony, brown	1.9	2.2
	Gravel Gravel: fine and coarse with cobbles; subangular to rounded Carboniferous sandstone, and rounded Carboniferous limestone, with some angular chert Sand: medium and coarse, angular to rounded; lithic grains and quartz Fines: moderate yellowish brown	12.0	14.2

	Clay, greyish orange, sandy, soft	0.2	14.4
Upper Magnesian Limestone	Limestone, dolomitic, very pale orange	1.0+	15.4

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines		Sand			Gravel	
				$-\frac{1}{16}$	$+\frac{1}{16} - \frac{1}{4}$	$+\frac{1}{4} - 1$	$+1 - 4$	$+4 - 16$	$+16 - 64$	$+64$ mm
3	25	72	2.2-3.2	2	2	5	10	31	49	1
			3.2-4.2	2	3	14	20	34	24	3
			4.2-5.2	6	3	14	10	34	33	0
			5.2-6.2	2	2	8	12	33	41	2
			6.2-7.2	2	3	11	6	19	56	3
			7.2-8.2	8	3	13	7	25	42	2
			8.2-9.2	3	2	7	12	41	32	3
			9.2-10.2	2	4	14	11	31	38	0
			10.2-11.2	1	1	6	7	20	38	27
			11.2-12.2	6	5	3	9	21	39	17
			12.2-13.2	2	3	17	17	27	27	7
			13.2-14.2	2	3	18	15	28	30	4
			Mean	3	3	11	11	29	37	6

SE 37 SW 101	3264 7493	Nunwick House	Block A
Surface level c.+26.0 m (+85 ft)			Overburden 1.2 m
Water not struck			Mineral 1.8 m
Shell and auger 200 mm			Waste 8.4 m
October 1982			Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Made ground	0.5	0.5
River Terrace Deposits	Clay, dark brown, silty	0.2	0.7
	Clay, mottled yellow and grey, with rounded pebbles	0.5	1.2
	Gravel	1.8	3.0
	Gravel: coarse and fine, subrounded to well-rounded; Carboniferous sandstone, with limestone		
	Sand: mainly medium, subangular to subrounded; quartz with some limestone		
Till	Clay, reddish brown; stony; pebbles of Carboniferous sandstone and limestone, with some angular fragments of Triassic sandstone; sandy below 5.3 m	8.4	11.4
Upper Permian Marl	Mudstone, greenish grey	0.2+	11.6

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines		Sand			Gravel	
				$-\frac{1}{16}$	$+\frac{1}{16} - \frac{1}{4}$	$+\frac{1}{4} - 1$	$+1 - 4$	$+4 - 16$	$+16 - 64$	$+64$ mm
2	20	78	1.2-3.0	2	2	11	7	29	49	0

SE 37 SW 102 3477 7444 Hutton Moor House

Block B

Surface level +39.9 m (+131 ft)
 Water not struck
 Shell and auger 200 mm
 November 1982

Waste 3.5 m
 Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
Till	'Clayey' sand Sand: fine, angular to subangular quartz, with sporadic pebbles of Carboniferous sandstone Fines: moderate reddish brown silt and clay	2.7	3.1
	Clay, reddish brown; sandy, hard	0.4	3.5
Sherwood Sandstone Group	Sandstone, fine-grained, reddish brown	0.1+	3.6

SE 37 SW 103 3165 7366 Ripon Parks

Block A

Surface level +22.3 m (+73 ft)
 Water struck at 21.3 m
 Shell and auger 250 mm
 November 1982

Overburden 0.5 m
 Mineral 10.5 m
 Waste 0.5 m
 Mineral 11.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.5	0.5
Alluvium	a Gravel Gravel: fine and coarse, with some cobbles; rounded to well-rounded Carboniferous sandstone and limestone, with some chert Sand: medium and coarse, subangular to subrounded quartz and lithic grains Fines: pale brown silt and clay	8.0	8.5
Sand and Gravel of unknown age	b 'Clayey' sand Sand: fine, subangular to subrounded quartz with some lithic grains Fines: moderate reddish brown silt and clay	2.5	11.0
	Silt, very sandy, moderate reddish brown; laminated, stoneless; moderate brown clay laminae	0.5	11.5
	c Pebbly sand Gravel: mainly fine, rounded, Carboniferous limestone and sandstone, with some Magnesian Limestone Sand: mainly medium, subangular, lithic grains with some quartz Fines: pale brown silt and clay	3.0	14.5
	d 'Clayey' pebbly sand Gravel: fine, rounded Carboniferous limestone and sandstone, with some Magnesian Limestone; cemented with calcareous tufa in part Sand: mainly medium, lithic grains with quartz Fines: pale brown silt and clay	4.0	18.5

e Gravel

4.0+ 22.5

Gravel: fine and coarse with cobbles; Carboniferous limestone and sandstone, with some Magnesian Limestone; cemented with calcareous tufa in part
 Sand: medium and coarse; subangular lithic grains with some quartz
 Fines: pale brown silt and clay

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
						-1/8	+1/8 - 1/4	+1/4 - 1	+1 - 4	+4 - 16	+16 - 64
a	3	24	73	0.5-1.5	2	3	18	14	31	31	1
				1.5-2.5	1	0	1	6	36	54	2
				2.5-3.5	2	2	7	12	32	45	0
				3.5-4.5	4	3	9	8	31	42	3
				4.5-5.5	7	2	6	10	38	36	1
				5.5-6.5	3	3	13	12	28	38	3
				6.5-7.5	2	3	10	9	35	35	6
				7.5-8.5	6	12	19	13	24	20	6
			Mean	3	3	10	11	32	38	3	
b	18	79	3	8.5-11.0	18	72	6	1	2	1	0
c	5	74	21	11.5-14.5	5	12	43	19	16	5	0
d	14	81	5	14.5-18.5	14	9	43	29	5	0	0
e	4	29	67	18.5-19.5	3	6	22	21	16	26	6
				19.5-20.5	4	2	9	19	15	28	23
				20.5-21.5	4	3	6	10	26	45	6
				21.5-22.5	5	2	5	15	31	37	5
				Mean	4	3	10	16	22	35	10
a-e	7	49	44	Mean	7	14	20	15	19	22	3

SE 37 SW 104 3428 7367 Lawson Barn

Block B

Surface level c.+50.0 m (+164 ft)
 Water not struck
 Shell and auger 200 mm
 September 1982

Waste 1.9 m
 Bedrock 1.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Sandy Till	'Very clayey' sand Sand: fine, subangular to rounded, quartz with some lithic grains Fines: moderate reddish orange	1.6	1.9
Sherwood Sandstone Group	Sandstone, fine-grained, moderate reddish brown; bands of mudstone	1.1+	3.0

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines		Sand			Gravel	
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
27	72	1	0.3-1.0	36	55	4	3	0	2	0
			1.0-1.9	20	75	4	1	0	0	0
			Mean	27	66	4	2	0	1	0

SE 37 SW 105 3038 7256 High Common Block A

Surface level +53.4 m (+175 ft) Waste 16.3 m
 Water not struck Bedrock 0.2 m+
 Shell and auger 200 mm
 November 1982

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Till	Clay, stony; moderate brown and sandy, becoming dusky brown and less sandy below 3.8 m; clasts include Carboniferous sandstone and limestone, Permo-Triassic mudstone (below 10.0 m)	11.2	11.5
Laminated Clay closely associated with Glacial Deposits	Clay, moderate reddish brown, with thin laminae of very pale orange silt, pebbles of Magnesian Limestone	0.2	11.7
	Clay, laminated with silt; stoneless to 14.0 m then sporadic pebbles of Carboniferous sandstone and Magnesian Limestone; dusky yellowish brown clay, with very pale orange silt laminae; firm	3.7	15.4
Till	Clay, moderate reddish brown; clasts up to cobble size; hard	0.9	16.3
Middle Permian Marl	Mudstone, greenish grey, fissile, hard	0.2+	16.5

SE 37 SW 106 3155 7268 Ure Bank Block A

Surface level c.+22.5 m (+74 ft) Overburden 0.1 m
 Water struck but level not recorded Mineral 21.3 m+
 Shell and auger 200 mm
 November 1982

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, pebbly	0.1	0.1
Alluvium on Sand and Gravel of unknown age	Gravel Gravel: fine and coarse, rounded to well-rounded Carboniferous limestone and sandstone with some Magnesian Limestone and chert; cemented with calcareous tufa in part (below 15.0 m)	21.3+	21.4

Sand: fine to coarse, subangular, quartz with lithic grains
 Fines: reddish brown silt and clay to 11.4 m, then pale brown to 21.4 m; rare thin clay bands at c.12.0 m

Borehole abandoned because of operational difficulties

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines			Sand		Gravel	
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
4	35	61	0.1-1.0	0	4	14	8	27	47	0
			1.0-2.0	1	3	16	7	27	46	0
			2.0-3.0	1	2	7	7	27	56	0
			3.0-4.1	2	4	23	4	25	40	2
			4.1-5.4	7	4	24	7	19	32	7
			5.4-6.4	22	56	7	3	9	3	0
			6.4-7.4	4	12	8	14	46	16	0
			7.4-8.4	3	18	15	15	26	20	3
			8.4-9.4	4	15	11	13	29	28	0
			9.4-10.4	4	16	9	14	35	22	0
			10.4-11.4	4	7	5	6	35	43	0
			11.4-12.4	5	7	22	28	24	14	0
			12.4-13.4	3	5	25	22	17	26	2
			13.4-14.4	4	8	18	22	27	21	0
			14.4-15.9	9	3	14	24	26	24	0
			15.9-17.6	1	2	5	12	41	39	0
			17.6-21.4	2	2	7	19	38	32	0
			Mean	4	8	13	14	30	30	1

SE 37 SW 107 3338 7299 Hay Park

Block B

Surface level +61.0 m (+200 ft)
 Water not struck
 Shell and auger 200 mm
 October 1982

Waste 0.8 m
 Bedrock 1.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
Sandy Till	Soil and sandy rubble	0.8	0.8
Sherwood Sandstone Group	Sandstone, fine-grained, red, weathered	1.2+	2.0

SE 37 SW 108 3257 7157 Sharow Hall

Block A

Surface level +32.0 m (+105 ft)
 Water struck but level not recorded
 Shell and auger 200 mm
 November 1982

Waste 16.0 m
 Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Till	Clay, silty, sandy; mottled light brown and dark yellowish orange, soft; sporadic subrounded boulders of Carboniferous sandstone	0.8	1.1
	Clay, silty and slightly sandy, stony; moderate brown, firm; abundant clasts up to cobble size, commonly of Carboniferous sandstone	1.4	2.5
Sandy Till	Clay, very sandy, stony; moderate reddish brown, soft; sporadic pebbles of Triassic sandstone, Carboniferous sandstone and Permo-Triassic mudstone	4.4	6.9
Till	Clay, silty, slightly sandy, stony; moderate brown, hard	3.1	10.0
?	Clay, organic rich (including leaves), micaceous, soft	1.4	11.4
Till	Clay, sandy, stoneless, moderate reddish brown, with rare green spots, soft	4.6	16.0
Upper Permian Marl	Mudstone, moderate brown, very hard	0.1+	16.1

SE 37 SW 109 3340 7135 Sharow Hall Farm

Block B

Surface level +41.9 m (+137 ft)
 Water struck at +35.5 m
 Shell and auger 250 mm
 November 1982

Waste 19.6 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Till	Clay, very sandy, silty, stony, greyish red, firm; clasts up to boulder size include Carboniferous sandstone, quartzite and limestone, Triassic sandstone and quartz	2.7	3.0
	Clay, silty, sandy (less so with depth), very stony, greyish brown, hard; clasts as above but one granitic boulder at 12 m	9.5	12.5
	Clay, silty, very stony, greyish brown, firm; clasts include Carboniferous sandstone and limestone, Triassic sandstone and Permo-Triassic mudstone	5.9	18.4
Sandy Till	'Clayey' sand: fine to medium subrounded quartz with moderate reddish brown fines	1.2+	19.6

SE 37 SW 110 3423 7103 Warren Hill

Block B

Surface level +31.5 m (+103 ft)
 Water struck but level not recorded
 Shell and auger 250 mm
 October 1982

Waste 11.4 m
 Bedrock 0.5 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Till	Clay, silty, sandy, stony, moderate brown, firm; pebbles and boulders of Carboniferous sandstone, limestone and quartzite, with Triassic sandstone	8.7	9.0
	Clay, silty, slightly sandy, stony, dusky yellowish brown; clasts as above but with the addition of some chert	2.4	11.4
Sherwood Sandstone Group	Sandstone, moderate reddish brown	0.5+	11.9

SE 37 SW 111 3204 7026 Parkfield

Block A

Surface level +24.8 m (+81 ft)
 Water struck but level not recorded
 Shell and auger 250 mm
 October 1982

Overburden 1.2 m
 Mineral 1.4 m
 Waste 3.7 m
 Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.6	0.6
Fluvioglacial Terrace Deposits	Clay, slightly sandy, stony, firm; pebbles and cobbles	0.6	1.2
	'Very clayey' gravel Gravel: fine, coarse and cobbles; Carboniferous sandstone and limestone, Magnesian Limestone and quartzite Sand: mainly fine, subrounded quartz Fines: moderate brown silt and clay	1.4	2.6
Till	Clay, moderate brown, sandy, silty and stony, firm	2.3	4.9
	Clay, medium dark grey, interlaminated with greyish red silt/fine sand; stoneless	1.4	6.3
Middle Permian Marl	Mudstone/siltstone, moderate reddish brown, gypsiferous	0.2+	6.5

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines		Sand		Gravel		
				-1/16	+1/16 - 1/4	+1/4 - 1	+1 - 4	+4 - 16	+16 - 64	+64 mm
28	23	49	1.2-2.6	28	12	7	4	10	22	17

SE 37 SW 112 3347 7028 Hewick Bridge

Block B

Surface level +23.0 m (+75 ft)
 Water struck at +22.0 m
 Shell and auger 250 mm
 October 1982

Waste 12.4 m
 Bedrock 0.5 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
Till	Clay, sandy, stony, pale yellowish orange; clasts include Carboniferous sandstone and limestone pebbles and boulders	0.7	1.1
	Clay, silty, very stony, moderate brown, becoming greyish brown with depth; firm; clasts include chert Carboniferous sandstone and limestone and Triassic sandstone	11.3	12.4
Sherwood Sandstone Group	Sandstone, fine- to medium-grained, red, hard	0.5+	12.9

SE 37 SW 113 3384 7048 Bridge House

Block B

Surface level +29.0 m (+95 ft)
 Water struck but level not recorded
 Shell and auger 250 mm
 October 1982

Waste 9.2 m
 Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Made ground	0.4	0.4
Till	Clay, very sandy, stony; moderate yellowish brown to 1.0 m, then moderate reddish brown; sandy pods and lenses; clasts up to boulder size, commonly ice-scratched	1.4	1.8
	Clay, very sandy, very stony, moderate brown, soft; clasts, include ?Magnesian Limestone, Carboniferous sandstone and limestone	0.9	2.7
	Clay, silty, very stony, firm; clasts comprise angular to rounded Carboniferous sandstone and limestone	0.5	3.2
	Sand, fine-grained quartz, moderate brown; sporadic bands (20 mm thick) of laminated silt and clay, variegated dark yellowish brown and pale yellowish brown	0.8	4.0
	Clay, sandy and silty, greyish red, stony, firm; sporadic rounded clasts of Carboniferous sandstone and limestone, abundant granules	3.4	7.4
	'Very clayey' sand Sand: mainly fine, subangular to subrounded quartz Fines: moderate brown silt and clay	1.8	9.2
Sherwood Sandstone Group	Sandstone, moderate reddish brown, streaked with pale olive, hard	0.1+	9.3

SE 37 SE 39 3711 7463 South of Rainton

Block B

Surface level c.+37.3 m (+122 ft)
 Water not struck
 Shell and auger 200 mm
 October 1982

Waste 4.5 m
 Bedrock 0.5 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
Till	Clay, sandy, moderate brown; rounded cobbles of Carboniferous sandstone	1.2	1.6
	Clay, very sandy, moderate reddish brown	2.9	4.5
Sherwood Sandstone Group	Sandstone, red, hard	0.5+	5.0

SE 37 SE 40 3796 7398 The Carrs

Block B

Surface level +26.2 m (+86 ft)
 Water struck at +13.2 m
 Shell and auger 200 mm
 December 1982

Waste 15.0 m
 Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.5	0.5
Glacial Lake Deposits	Clay, brown, mottled with grey; rootlets	1.6	2.1
	Clay, moderate reddish brown, interlaminated with dusky red, stoneless, soft	2.6	4.7
Till	Clay, brown, stony, hard; rounded pebbles and cobbles of Carboniferous sandstone and limestone, with some angular Triassic sandstone	8.3	13.0
Glacial Sand and Gravel	Gravel Gravel: fine and coarse; well-rounded, Carboniferous sandstone and limestone with trace of chert	2.0	15.0
Sherwood Sandstone Group	Sandstone, moderate reddish brown	0.1+	15.1

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines	Sand		Gravel			
				- $\frac{1}{8}$	+ $\frac{1}{8}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
3	17	80	13.0-15.0	3	6	5	6	37	39	4

Surface level +30.9 m (+101 ft)
 Water struck but level not recorded
 Shell and auger 200 mm
 November 1982

Overburden 2.0 m
 Mineral 8.3 m
 Waste 10.2 m
 Bedrock 2.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Till	Clay, moderate yellowish brown, sandy	1.7	2.0
Glacial Sand and Gravel	'Very clayey' sand Sand: fine, subangular to angular, quartz Fines: moderate reddish brown silt and clay	8.3	10.3
Till	Clay, dusky brown, firm; cobbles of Carboniferous limestone and sandstone	9.4	19.7
Glacial Sand and Gravel	Gravel Gravel: fine and coarse, rounded; Carboniferous lithologies	0.8	20.5
Sherwood Sandstone Group	Sandstone, moderate reddish brown, soft, weathered	2.0+	22.5

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines		Sand		Gravel		
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
24	74	2	2.0-7.9	28	66	2	1	3	0	0
			7.9-10.3	14	85	1	0	0	0	0
			Mean	24	71	2	1	2	trace	0

Surface level +26.1 m (+86 ft)
 Water struck at +23.3 m
 Shell and auger 200 mm
 October 1982

Overburden 0.4 m
 Mineral 9.5 m
 Waste 14.8 m
 Bedrock 0.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
Glacial Sand and Gravel	Gravel Gravel: coarse and fine, with cobbles; subangular to rounded Carboniferous sandstone with some limestone and quartz, trace ?Borrowdale volcanics; with increasing depth Triassic mudstone fragments become dominant Sand: mainly fine, subrounded; quartz with lithic grains Fines: moderate yellowish brown silt and clay	9.5	9.9
	Clay, silty and sandy, pale yellowish brown, soft; pebbles of sandstone with Carboniferous limestone	8.6	18.5

Till	Clay sandy, medium dark grey, soft; pebbles and cobbles of Carboniferous limestone with Carboniferous sandstone	3.5	22.0
	Clay, very sandy, moderate reddish brown, soft; numerous pebbles of Triassic sandstone	2.7	24.7
Sherwood Sandstone Group	Sandstone, moderate reddish brown, fine-grained	0.3+	25.0

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16} - \frac{1}{4}$	$+\frac{1}{4} - 1$	$+1 - 4$	$+4 - 16$	$+16 - 64$	$+64$ mm
6	30	64	0.4-2.8	5	19	7	9	21	28	11
			2.8-3.8	5	9	3	5	12	47	19
			3.8-5.8	11	13	11	12	25	24	4
			5.8-6.8	4	6	5	9	26	43	7
			6.8-7.8	6	5	3	9	21	39	17
			7.8-8.8	4	9	7	11	15	39	15
			8.8-9.9	0	21	14	7	18	40	0
			Mean	6	13	8	9	20	34	10

SE 37 SE 43 3589 7366 Hutton Moor Block B

Surface level +54.0 m (+177 ft) Waste 1.3 m
 Water not struck Bedrock 0.1 m+
 Shell and auger 200 mm
 October 1982

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Sandy Till	'Very clayey' sand Sand: fine, quartz Fines: moderate reddish brown silt and clay	1.0	1.3
Sherwood Sandstone Group	Sandstone, moderate reddish brown, weathered	0.1+	1.4

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16} - \frac{1}{4}$	$+\frac{1}{4} - 1$	$+1 - 4$	$+4 - 16$	$+16 - 64$	$+64$ mm
21	78	1	0.3-1.3	21	72	4	2	1	0	0

SE 37 SE 44 3769 7350 Pasture Hills

Block B

Surface level +28.7 m (+94 ft)
 Water struck but level not recorded
 Shell and auger 200 mm
 October 1982

Waste 8.9 m
 Bedrock 0.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
Till	Clay, silty, stony, pale brown; cobbles of sandstone; pebbles of Carboniferous limestone and Triassic sandstone	2.6	3.0
	Clay, stony, moderate brown, becoming greyish brown; pebbles of Carboniferous limestone and sandstone	5.9	8.9
Sherwood Sandstone Group	Sandstone, red, medium-grained, weathered	0.3+	9.2

SE 37 SE 45 3877 7341 Dishforth

Block C

Surface level +27.7 m (+91 ft)
 Water struck at +24.9 m
 Shell and auger 200 mm
 October 1982

Overburden 1.6 m
 Mineral 7.8 m
 Waste 6.1 m
 Mineral 2.1 m
 Bedrock 1.6 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Till	Clay, sandy, with cobbles of Carboniferous sandstone	1.3	1.6
Glacial Sand and Gravel	a Sand Sand: fine, angular, quartz Fines: moderate reddish brown	7.8	9.4
Laminated Clay closely associated with Glacial Deposits	Clay, moderate reddish brown, with silt laminae; small pods of red sand	1.0	10.4
Till	Clay, silty, moderate brown, becoming greyish brown, firm, stony; rounded pebbles of Carboniferous sandstone and limestone	5.1	15.5
Glacial Sand and Gravel	b Gravel Gravel: coarse and fine, Carboniferous limestone and sandstone Sand: fine to coarse, angular, quartz with some lithic grains	2.1	17.6
Sherwood Sandstone Group	Sandstone, moderate reddish brown, weathered to 19.0 m	1.6+	19.2

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines			Gravel			
					- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
a	7	93	0	1.6-4.8	6	90	3	1	0	0	0
				4.8-7.8	7	91	1	1	0	0	0
				7.8-9.4	8	90	1	1	0	0	0
				Mean	7	90	2	1	0	0	0
b	9	15	76	15.5-17.6	9	6	4	5	24	52	0
a+b	7	77	16	Mean	7	74	2	1	5	11	0

SE 37 SE 46	3990 7368	Coram Hills	Block D
Surface level +21.2 m (+70 ft)			Overburden 0.7 m
Water struck at +18.0 m			Mineral 7.1 m
Shell and auger 200 mm			Waste 5.3 m
October 1982			Bedrock 0.5 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Till	Clay, sandy, brown	0.4	0.7
Glacial Sand and Gravel	Gravel (pebbly sand to 1.1 m) Gravel: fine and coarse, with some cobbles; subangular to well-rounded Carboniferous sandstone with some Carboniferous limestone and traces of dolomitic limestone Sand: fine to coarse, angular quartz and lithic grains	7.1	7.8
Till	Clay, greyish brown, silty, stony; sandy at base; pebbles of Carboniferous sandstone and limestone	5.3	13.1
Sherwood Sandstone Group	Sandstone, moderate reddish brown	0.5+	13.6

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines			Gravel			
					- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
	5	31	64	0.7-1.1	28	47	15	2	5	3	0
				1.1-3.2	3	18	10	9	17	42	1
				3.2-4.2	2	8	8	10	17	43	12
				4.2-5.2	3	9	8	9	27	42	2
				5.2-6.2	7	21	5	11	23	24	9
				6.2-7.8	5	4	4	10	40	37	0
				Mean	5	14	8	9	23	37	4

SE 37 SE 47 3650 7261 Oxenblast Hill

Block B

Surface level +50.8 m (+167 ft)
 Water not struck
 Shell and auger 200 mm
 October 1982

Waste 3.0 m
 Bedrock 0.8 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Sandy Till	'Very clayey' pebbly sand Gravel: fine and coarse, Carboniferous and Triassic sandstone Sand: mainly fine, subangular quartz	2.7	3.0
Sherwood Sandstone Group	Sandstone, moderate reddish brown	0.8+	3.8

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines	Sand		Gravel			
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
27	55	18	0.3-3.0	27	46	6	3	9	9	0

SE 37 SE 48 3771 7247 Mill Stoops

Block C

Surface level +37.7 m (+124 ft)
 Water not struck
 Shell and auger 200 mm
 November 1982

Overburden 2.0 m
 Mineral 2.8 m
 Waste 3.4 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil and made ground	1.1	1.1
Till	Clay, medium dark grey, with greyish black and dusky yellow mottling (?oxidation/reduction)	0.9	2.0
Glacial Sand and Gravel	'Very clayey' sand Sand: mainly fine, subangular quartz Fines: moderate reddish brown	2.8	4.8
Till	Clay, dusky brown, sandy and stony; clasts include cobbles of Carboniferous sandstone and limestone	3.4+	8.2

Borehole abandoned due to operational difficulties

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines	Sand		Gravel			
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
24	75	1	2.0-4.8	24	64	8	3	1	0	0

SE 37 SE 49 3890 7225 Grave Hill Block B

Surface level c.+29.0 m (+95 ft) Waste 7.9 m
 Water not recorded Bedrock 0.6 m+
 Shell and Auger 200 mm
 November 1982

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil and made ground	1.5	1.5
Sandy Till	'Very clayey' sand, moderate reddish brown, with sporadic Carboniferous sandstone pebbles	0.5	2.0
Till	Clay, dusky brown; silty and sandy, stony, hard; abundant clasts of Carboniferous lithologies with some Magnesian Limestone	5.9	7.9
Sherwood Sandstone Group	Sandstone, moderate reddish brown, weathered	0.6+	8.5

SE 37 SE 50 3539 7111 Oxforth Hill Block B

Surface level +39.3 m (+129 ft) Waste 13.7 m
 Water not struck Bedrock 0.1 m+
 Shell and auger 200 mm
 November 1982

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
Sandy Till	Clay, very sandy, stoneless, moderate reddish brown, soft	5.5	5.9
Till	Clay, silty, slightly sandy, very stony, moderate brown; abundant pebbles and sporadic boulders of Carboniferous limestone and sandstone	7.8	13.7
Sherwood Sandstone Group	Sandstone, red, weathered, very hard	0.1+	13.8

SE 37 SE 51 3725 7130 Stonebridge Gutter Block B

Surface level +39.9 m (+131 ft) Waste 2.0 m
 Water not struck Bedrock 0.2 m+
 Shell and auger 200 mm
 October 1982

LOG

Geological classification	Lithology	Thickness m	Depth m
Till	Soil and clayey sand	1.1	1.1
	Clay, moderate brown, sandy	0.9	2.0
Sherwood Sandstone Group	Sandstone, red, weathered	0.2+	2.2

SE 37 SE 52 3892 7106 North Hill

Block B

Surface level +29.6 m (+97 ft)
 Water not struck
 Shell and auger 200 mm
 October 1982

Waste 3.9 m
 Bedrock 0.6 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Till	'Clayey' sand, moderate reddish brown	0.5	0.7
	Clay, silty, stony, moderate brown, soft to firm; clasts include Carboniferous sandstone and limestone; sandy at base	3.2	3.9
Sherwood Sandstone Group	Sandstone, moderate reddish brown, weathered	0.6+	4.5

SE 37 SE 53 3656 7055 Manor House

Block B

Surface level +49.3 m (+162 ft)
 Water struck at +41.7 m
 Shell and auger 250 mm
 November 1982

Waste 15.5 m
 Bedrock 0.5 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Till	'Clayey' sand: fine, subrounded quartz, rare quartzite pebbles, very pale orange	0.6	0.8
	Clay, moderate brown; crudely interlaminated with fine- grained sand; soft; sporadic sandstone clasts	6.7	7.5
	Clay, very sandy, moderate brown, slightly stony, with some boulders, abundant granules, firm; clasts comprise Carboniferous sandstone and limestone, with Permo-Triassic sandstone, and are commonly ice-scratched; below 8.0 m becomes silty and less sandy, olive black	0.6	8.1
	Clay, silty, very sandy, moderate brown, soft; sporadic clasts of crumbly Permo-Triassic sandstone	4.9	13.0
	Clay, silty, very stony, dark greyish brown, firm; clasts comprise abundant angular and subrounded lithic granules, sporadic subrounded pebbles of Carboniferous sandstone and limestone with rare basic extrusives	1.6	14.6
	'Clayey' sand: medium, subrounded quartz with rare pebbles, moderate reddish brown	0.9	15.5
Sherwood Sandstone Group	Sandstone, red; angular fragments of hard sandstone in a sandy matrix	0.5+	16.0

SE 37 SE 54 3928 7046 Town End Fields

Block B

Surface level +33.8 m (+111 ft)
 Water not struck
 Shell and auger 200 mm
 November 1982

Waste 1.6 m
 Bedrock 0.4 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Till	'Clayey' sand: fine, quartz, moderate reddish brown	1.3	1.6
Sherwood Sandstone Group	Sandstone, red; fragments of sandstone in a sandy matrix	0.4+	2.0

SE 47 NW 57 4108 7924 Warren Farm

Block E

Surface level +24.8 m (+81 ft)
 Water struck at +23.3 m
 Shell and auger 200 mm
 December 1982

Overburden 1.5 m
 Mineral 1.5 m
 Waste 16.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	1.5	1.5
Glacial Lake Deposits	'Clayey' sand Sand: mainly fine, quartz; some coal fragments Fines: greyish brown	1.5	3.0
	Clay, silty, greyish brown, laminated; silty in parts with some very fine sand	15.6	18.6
	Silt with fine sand and some clay bands, greyish brown	0.4+	19.0

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- $\frac{1}{8}$	+ $\frac{1}{8}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1-4	+4-16	+16-64	+64 mm
11	89	0	1.5-3.0	11	72	15	2	0	0	0

SE 47 NW 58	4317 7961	Ox Moor Plantation	Block E
Surface level +30.4 m (+100 ft)			Overburden 2.1 m
Water struck at +27.4 m			Mineral 2.8 m
Shell and auger 200 mm			Waste 5.7 m
December 1982			Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, sandy	0.6	0.6
Glacial Lake Deposits	Clay, dark yellowish brown, silty, stoneless, massive, soft; contains organic fragments and rootlets	1.5	2.1
	a Gravel Gravel: fine and coarse, rounded Carboniferous sandstone and limestone with some Palaeozoic mudstone, chert and Triassic sandstone Sand: fine to coarse, lithic grains Fines: pale yellowish brown silt and clay	1.7	3.8
	b 'Clayey' pebbly sand Gravel: mainly fine, Carboniferous sandstone and limestone with some Triassic sandstone Sand: mainly medium, lithic grains with quartz Fines: dark yellowish brown silt and clay	1.1	4.9
	Clay, greyish brown, silty, stoneless, laminated, soft	2.4	7.3
Till	Clay, silty, stony, dark reddish brown, becoming greyish red, firm; clasts include subrounded pebbles of Carboniferous lithologies and angular Triassic lithologies	3.3	10.6
Mercia Mudstone Group	Mudstone/Siltstone, medium grey, gypsiferous	0.1+	10.7

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
						- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64
a	2	32	66	2.1-3.1 3.1-3.8 Mean	2 2 2	4 10 7	11 15 12	14 11 13	46 37 43	20 25 22	3 0 1
b	11	84	5	3.8-4.9	11	14	66	4	4	1	0
a+b	6	52	42	Mean	6	9	33	10	27	14	1

SE 47 NW 59 4430 7983 Spring House

Block E

Surface level +31.2 m (+102 ft)
 Water struck at +28.8 m
 Shell and auger 200 mm
 January 1983

Waste 10.7 m
 Bedrock 0.4 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Glacial Lake Deposits	Clay, silty, dark yellowish brown, with medium bluish grey partings, laminated	2.2	2.4
	Gravel ('clayey' to 'very clayey' <i>in situ</i>), with moderate reddish brown clay; generally fine pebbles of subangular to subrounded, Carboniferous limestone and sandstone, Permo-Triassic greyish green siltstone and rare porphyritic volcanic rocks	0.9	3.3
Till	Clay, stony, sandy, moderate brown, very hard; clasts comprise mainly fine, subangular to subrounded, sandstone, limestone and greyish green siltstone	7.4	10.7
Mercia Mudstone Group	Mudstone, moderate reddish brown and greenish grey	0.4+	11.1

SE 47 NW 60 4067 7832 Topcliffe Airfield

Block E

Surface level +25.2 m (+83 ft)
 Water not struck
 Shell and auger 200 mm
 December 1982

Waste 16.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Glacial Lake Deposits	Clay, laminated, greyish brown, stoneless, soft; clay and silt alternating with thin laminae of fine sand; weathered to a depth of 1.1 m, otherwise uniform	13.2	13.5
Till	Clay, silty, very stony, dusky brown; Carboniferous clasts common, particularly pebbles of crinoidal limestone, sandstone, quartzite and grits	1.5	15.0
	Clay, very sandy, stony, moderate reddish brown; clasts as above	1.0+	16.0
Borehole abandoned due to operational difficulties			

SE 47 NW 61 4173 7879 Thorpefield Block E

Surface level +24.9 m (82 ft) Overburden 0.3 m
 Water struck at +24.0 m Mineral 2.1 m
 Shell and auger 200 mm Waste 17.0 m+
 December 1982

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Glacial Lake Deposits	'Clayey' sand Sand: mainly fine, quartz Fines: dark yellowish brown	2.1	2.4
	Silt and clay, greyish brown; slightly sandy at the top, sporadic silt partings throughout, laminated, firm	17.0+	19.4

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
16	83	1	0.3-2.4	16	57	23	3	1	0	0

SE 47 NW 62 4272 7858 Cod Beck Farm Block E

Surface level +25.8 m (+85 ft) Overburden 0.2 m
 Water struck at +25.3 m Mineral 1.1 m
 Shell and auger 200 mm Waste 10.2 m
 December 1982 Bedrock 0.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Glacial Lake Deposits	'Very clayey' sand Sand: mainly fine, quartz Fines: dark yellowish brown silt and clay	1.1	1.3
	Clay, silty, laminated, greyish brown, with moderate reddish brown fine-grained sand laminae below 8.5 m; plant fragments at 2.0 m (roots)	9.2	10.5
Till	Clay, silty and stony, moderate brown but becoming reddish below 10.8 m; clasts predominantly angular, tabular siltstone granules and pebbles	1.0	11.5
Mercia Mudstone Group	Siltstone, greenish grey, with dark greenish grey bedding planes	0.3+	11.8

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
24	75	1	0.2-1.3	24	41	30	4	1	0	0

SE 47 NW 63 4399 7865 Sowerby Parks Block E

Surface level c.+28.0 m (+92 ft) Waste 4.0 m
 Water not struck Bedrock 0.5 m+
 Shell and auger 200 mm
 December 1982

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Glacial Lake Deposits	Clay, sandy, yellowish brown	1.3	1.6
	Clay, dusky brown	0.6	2.2
	Clay, dusky brown, laminated, soft	1.0	3.2
Till	Clay, silty, stony, moderate brown, with reddish tinge; clasts include greenish grey mudstone fragments	0.8	4.0
Mercia Mudstone Group	Siltstone, greenish grey	0.5+	4.5

SE 47 NW 64 4458 7783 Islebeck Lane Block E

Surface level +28.0 m (+92 ft) Waste 17.0 m
 Water not recorded Bedrock 0.5 m+
 Shell and auger 200 mm
 January 1983

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.1	0.1
Glacial Lake Deposits	Clay, silty, dark yellowish brown, streaked with medium bluish grey; laminated at base	1.6	1.7
Till	Clay, greyish brown; sporadic pebbles and granules of subangular to subrounded limestone	1.8	3.5
	Clay, stony, moderate brown, very hard; clasts comprise granules and pebbles of subrounded to subangular limestone and sandstone with Permo-Triassic siltstone and sandstone and rare coarse-grained igneous lithologies; with depth, clay becomes softer, more reddish in hue and silty in texture	12.5	16.0

	Clay, sandy, silty and stony, olive black, soft to firm; clasts include subangular to subrounded pebbles of limestone, sandstone, quartzite and quartz; increasing abundance of marl fragments approaching 17.0 m	1.0	17.0
Mercia Mudstone Group	Marl, gypsiferous, moderate brown, dark reddish brown and greenish grey; 15 mm veins of gypsum	0.5+	17.5

SE 47 NW 65 4100 7688 Common House Block E

Surface level +24.3 m (+80 ft) Waste 19.6 m
Water struck at +13.3 m Bedrock 0.1 m+
Shell and auger 200 mm
December 1982

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.5	0.5
Glacial Lake Deposits	Clay, silty, slightly sandy, stoneless, mottled moderate brown and yellow and orange, soft friable, gleyed, weathered	1.1	1.6
	Clay, silty, stoneless, greyish brown, soft	1.0	2.6
	Clay, laminated, stoneless, greyish brown; thin laminae of moderate reddish brown, fine-grained sand and very pale orange, micaceous silt; clay becomes dark grey with depth	6.5	9.1
Till	Clay, silty, sandy, stony, greyish reddish brown, firm; abundant granules and pebbles of rounded Carboniferous limestone and sandstone, and angular Triassic sandstone and mudstone	2.9	12.0
Glacial Sand and Gravel	Gravel Gravel: coarse with cobbles; Carboniferous limestone and sandstone, with some Triassic sandstone Fines: pale brown; sporadic thin bands (20 mm) of pale brown laminated clay	1.4	13.4
	Clay, very sandy, stony, moderate reddish brown; rare rounded pebbles of Carboniferous limestone and sandstone; although the sample was graded as 'very clayey' sand, the <i>in situ</i> lithology probably included more fines	6.2	19.6
Sherwood Sandstone Group	Sandstone, very hard, dark reddish brown	0.1+	19.7

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
21	63	16	12.0-13.4	4	5	3	4	11	49	24
			13.4-19.6	25	64	6	4	1	0	0
			Mean	21	54	5	4	3	9	4

SE 47 NW 66 4137 7768 Thacker Beck Wood Block E

Surface level c.+23.0 m (+75 ft) Waste 16.4 m
 Water not struck Bedrock 0.2 m+
 Shell and auger 200 mm
 December 1982

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
Glacial Lake Deposits	Clay, laminated, greyish brown, stoneless, soft; silt and fine sand laminae throughout	14.9	15.3
Till	Clay, silty, sandy, stony, greyish reddish brown, firm; common granules and pebbles of Carboniferous limestone and sandstone and Triassic sandstone and mudstone	1.1	16.4
Mercia Mudstone Group	Mudstone, greyish red, fissile; veins of gypsum	0.2+	16.6

SE 47 NW 67 4281 7747 Paradise House Block E

Surface level c.+24.0 m (+79 ft) Waste 9.0 m
 Water not struck Bedrock 0.5 m+
 Shell and auger 200 mm
 December 1982

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Glacial Lake Deposits	Clay, dusky brown, laminated, stoneless, soft; silt laminae throughout	7.9	8.1
Till	Clay, stony, dusky brown; clasts comprise Triassic lithologies	0.9	9.0
Mercia Mudstone Group	Siltstone, medium dark grey, fissile, very hard	0.5+	9.5

SE 47 NW 68 4369 7838 Sowerby Parks Block E

Surface level c.+27.0 m (+89 ft) Waste 11.4 m
 Water struck but level not recorded Bedrock 1.6 m+
 Shell and auger 200 mm
 December 1982

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Glacial Lake Deposits	Clay, laminated, greyish brown; weathered at top	8.1	8.4
Till	Clay, stony, moderate reddish brown; clasts comprise Carboniferous limestone and sandstone with Triassic mudstone	3.0	11.4
Mercia Mudstone Group	Mudstone, dark reddish brown, fissile; veins of gypsum	1.6+	13.0

SE 47 NW 69 4418 7688 West of Rush Wood, Dalton

Block E

Surface level +27.0 m (+89 ft)
 Water not struck
 Shell and auger 200 mm
 January 1983

Waste 8.5 m
 Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.5	0.5
Glacial Lake Deposits	Sand, medium, subangular quartz, dark yellowish brown	0.3	0.8
	Clay, dark yellowish brown, interlaminated with dark yellowish orange silt; stoneless, firm	1.6	2.4
Till	Clay, silty, very stony, greyish reddish brown, firm; abundant clasts, pebble to cobble, rounded Carboniferous limestone and sandstone, angular to rounded Triassic sandstone and mudstone	6.1	8.5
Mercia Mudstone Group	Siltstone, greenish grey, slightly sandy, very hard; veins of gypsum	0.2+	8.7

SE 47 NW 70 4211 7644 Dalton Lane

Block E

Surface level +21.1 m (+69 ft)
 Water not struck
 Shell and auger 200 mm
 December 1982

Waste 15.7 m
 Bedrock 0.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil and made ground	0.1	0.1
Glacial Lake Deposits	Clay, laminated, greyish brown, soft; weathered above 2.8 m	12.4	12.5
	Clay, stony, dark reddish brown; clasts comprise pebbles of rounded Triassic sandstone and angular Triassic mudstone	3.2	15.7
Mercia Mudstone Group	Siltstone, grey, micaceous; veins of gypsum	0.3+	16.0

SE 47 NW 71 4327 7677 Willow Bridge

Block E

Surface level +23.7 m (+78 ft)
 Water not struck
 Shell and auger 200 mm
 January 1983

Waste 6.0 m
 Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil and made ground	0.8	0.8
Glacial Lake Deposits	Clay, moderate brown, interlaminated with bluish grey silt	2.7	3.5

	Silt, dark grey, clayey, micaceous	0.6	4.1
Till	Clay, moderate brown, stony; clasts comprise angular pebbles of pale greyish green siltstone, with rounded Carboniferous limestone and sandstone increasing in abundance with depth	1.9	6.0
Lias	Siltstone, dark grey, very hard	0.1+	6.1

SE 47 NW 72	4394 7597	Sandholmes	Block E
Surface level +26.3 m (+86 ft)		Overburden	0.4 m
Water not struck		Mineral	1.7 m
Shell and auger 200 mm		Waste	6.6 m
January 1983		Bedrock	0.5 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
Glacial Lake Deposits	'Very clayey' sand Sand: fine, quartz; common coal fragments Fines: strong yellowish orange silt and clay	1.7	2.1
	Clay, dark yellowish brown, laminated, stoneless, firm	1.7	3.8
Till	Clay, silty, stony, moderate brown with sporadic patches of moderate reddish brown, firm; abundant small angular pebbles of Carboniferous limestone and sandstone with some rounded limestone	4.9	8.7
Mercia Mudstone Group	Mudstone, variegated greyish red and olive grey, very hard, fissile; veins of gypsum; thin bands of greenish grey siltstone and sandstone	0.5+	9.2

SE 47 NW 73	4472 7646	Scaife Shay Bridge	Block E
Surface level c.+27.0 m (+89 ft)		Waste	7.5 m
Water not struck		Bedrock	0.2 m+
Shell and auger 200 mm			
January 1983			

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Glacial Lake Deposits	'Very clayey' sand: fine, subangular, quartz, light brown	0.6	0.9
	Clay, laminated, greyish brown with subvertical streaks of greyish blue, firm, stoneless; weathered at top	2.4	3.3
Till	Clay, greyish brown, silty, sandy, stony, soft; clasts predominantly angular to subrounded Carboniferous limestone and sandstone	4.2	7.5
Lias	Mudstone, greyish black, fissile, very hard	0.2+	7.7

SE 47 NW 74 4121 7570

South of Dalton Bridges

Block E

Surface level +22.5 m (+74 ft)
 Water not recorded
 Shell and auger 200 mm
 December 1982

Waste 19.7 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
Glacial Lake Deposits	'Clayey' sand, yellowish brown	0.8	1.2
	Clay, yellowish brown, sandy	1.7	2.9
	Clay, laminated, brown	9.3	12.2
Till	Clay, moderate reddish brown; clasts of Carboniferous sandstone and Triassic mudstone; laminated in part	0.5	12.7
Laminated Clay closely associated with Glacial Deposits	Silt, grey to moderate reddish brown, alternating with moderate reddish brown clay; sporadic pebbles of Carboniferous sandstone	3.3	16.0
Glacial Sand and Gravel	'Clayey' sand Sand: fine, quartz Fines: moderate reddish brown	3.5	19.5
Till	Clay, moderate reddish brown, silty; sporadic sandy partings	0.2+	19.7

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines		Sand			Gravel	
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
16	84	0	16.0-17.0	14	77	6	2	1	0	0
			17.0-19.5	17	76	4	3	0	0	0
			Mean	16	77	4	3	trace	0	0

SE 47 NW 75 4190 7540

Eldmire Lane

Block E

Surface level +18.9 m (+62 ft)
 Water not struck
 Shell and auger 200 mm
 December 1982

Waste 19.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Glacial Lake Deposits	Clay, sandy, dark yellowish orange	1.0	1.2
	Clay, greyish brown, firm	2.0	3.2
	Clay, greyish brown, laminated, soft	5.2	8.4
	Silt, pale brown, soft	1.9	10.3
	Clay, dusky brown, laminated, stoneless, soft to firm	8.7+	19.0

SE 47 NW 76 4307 7565 Pit Ings Lane

Block E

Surface level +24.5 m (+80 ft)
 Water struck at +20.2 m
 Shell and auger 200 mm
 December 1982

Waste 4.4 m
 Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
Glacial Lake Deposits	'Clayey' sand: fine, quartz, dark yellowish brown fines	0.8	1.2
	Clay, silty; dusky yellowish brown, mottled with medium bluish grey; laminated	1.2	2.4
Till	Clay, moderate brown; coarse sand and fine gravel-size clasts of Triassic siltstone and some Carboniferous sandstone; becoming very stony - predominantly greenish grey siltstone up to cobble size	2.0	4.4
Mercia Mudstone Group	Siltstone, calcareous, greenish grey, very hard	0.1+	4.5

SE 47 NW 77 4409 7514 Ox Close Lane, Eldmire

Block E

Surface level +26.1 m (+86 ft)
 Water not struck
 Shell and auger 200 mm
 January 1983

Waste 4.0 m
 Bedrock 0.4 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Glacial Lake Deposits	Clay, dark yellowish brown, interlaminated with very pale orange and light bluish grey silt; stoneless, firm	1.1	1.3
Till	Clay, greyish red, silty, slightly sandy, stony, hard; abundant granules of Triassic and Carboniferous lithologies, common angular to subrounded pebbles; much included bedrock below 3.8 m	2.7	4.0
Lias	Mudstone, dark grey, hard, fissile	0.4+	4.4

SE 47 NW 78 4465 7528 Cold Harbour

Block E

Surface level +30.0 m (+98 ft)
 Water not struck
 Shell and auger 200 mm
 December 1982

Waste 3.5 m
 Bedrock 0.5 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.5	0.5
Glacial Lake Deposits	'Very clayey' sand, fine, strong yellowish orange	0.7	1.2
Till	Clay, moderate reddish brown, silty, stony	2.3	3.5
Lias	Sandstone, greenish grey, hard, fine-grained, silty; small bivalves	0.5+	4.0

SE 47 SW 16 4091 7459 Sheephills

Block D

Surface level +33.8 m (+111 ft)
 Water struck at +31.1 m
 Shell and auger 200 mm
 December 1982

Overburden 2.6 m
 Mineral 5.6 m
 Waste 12.6 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Till	Clay, dark reddish brown, very stony, friable, hard, weathered; clasts comprise abundant pebbles and angular cobbles of Carboniferous limestone and sandstone with quartzite	2.3	2.6
Glacial Sand and Gravel	'Clayey' gravel Gravel: fine and coarse with some cobbles; Carboniferous sandstone and rounded limestone with Triassic mudstone and some igneous rocks Sand: fine to coarse, subangular to subrounded lithic grains with quartz Fines: moderate brown silt and clay	5.6	8.2
	Clay, moderate reddish brown, very sandy, stony, soft; sporadic clasts of subrounded to rounded Carboniferous sandstone and limestone, chert and Triassic and ?Jurassic mudstone	9.9	18.1
	Clay, moderate brown, very sandy, stony, soft; clasts as between 8.2 and 18.1 m	2.7+	20.8

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines	Sand		Gravel			
				- $\frac{1}{16}$	$+\frac{1}{16}$ - $\frac{1}{4}$	$+\frac{1}{4}$ - 1	+1 - 4	+4 - 16	+16 - 64	+64 mm
11	23	66	2.6-3.3	6	7	9	16	27	29	6
			3.3-4.3	11	7	8	13	29	30	2
			4.3-5.2	3	7	7	13	27	36	7
			5.2-8.2	14	7	4	9	30	33	3
			Mean	11	7	5	11	29	33	4

SE 47 SW 17 4138 7472 Leckby Grange

Block D

Surface level +20.4 m (+67 ft)
 Water struck but level not recorded
 Shell and auger 200 mm
 January 1983

Waste 11.7 m
 Bedrock 0.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Glacial Lake Deposits	Clay, variegated greyish brown, strong yellowish orange and medium grey, very sandy, stoneless, firm; sporadic thin laminated clay bands	3.1	3.4
Glacial Sand and Gravel	Clay, dark reddish brown, very sandy, stony, friable and soft; Triassic mudstone fragments, rounded pebbles of Carboniferous sandstone and limestone	2.5	5.9
	Clay, greyish red, with medium bluish grey spots; very sandy, stony, soft; pebbles of Carboniferous limestone and sandstone	2.8	8.7
Till	Clay, moderate brown, sandy, stony, firm; clasts mainly angular siltstone	3.0	11.7
Lias	Mudstone, dark grey, disturbed	0.2	11.9
	Mudstone, dark grey, hard, micaceous	0.1+	12.0

SE 47 SW 18 4247 7432 Eldmire Ings

Block D

Surface level +18.6 m (+61 ft)
 Water not struck
 Shell and auger 200 mm
 December 1982

Overburden 0.2 m
 Mineral 2.2 m
 Waste 1.9 m
 Mineral 4.3 m
 Waste 16.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Glacial Lake Deposits	a 'Very clayey' sand, mainly fine, quartz	2.2	2.4
	Clay, greyish brown, laminated	1.9	4.3
	b 'Very clayey' sand, Sand: fine, quartz with some lithic grains	4.3	8.6
	Clay, greyish brown, laminated, stoneless; sporadic thin silt and sand bands; below 14.1 m clay is interlaminated with silt and sand partings	14.9	23.5
	Clay, laminated, stony, greyish reddish brown; clasts include granules and pebbles of Carboniferous sandstone and limestone, and angular fragments of Triassic sandstone and greyish green mudstone	1.3+	24.8

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines		Sand			Gravel	
					- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ - 1	+1 - 4	+4 - 16	+16 - 64	+64 mm
a	24	76	0	0.2-2.4	24	54	20	2	0	0	0
b	33	67	0	4.3-8.6	33	66	1	trace	0	0	0
a+b	30	70	0	Mean	30	62	7	1	0	0	0

SE 47 SW 19 4323 7472 Low House Block E

Surface level +25.6 m (+87 ft) Waste 10.4 m
 Water not struck Bedrock 1.1 m+
 Shell and auger 200 mm
 December 1982

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Glacial Lake Deposits	Clay, dark yellowish brown, very sandy but less so with depth	0.9	1.1
	Clay, mottled medium bluish grey and strong yellowish orange, sandy	0.5	1.6
Till	Clay, moderate reddish brown, stony; clasts comprise sandstone and mudstone up to cobble size; transition in colour to moderate brown below 7.0 m with abundant subrounded mudstone predominant	8.8	10.4
Lias	Mudstone dark grey, hard; fossiliferous (bivalves)	1.1+	11.5

SE 47 SW 20 4461 7468 Eldmire Moor House Block E

Surface level +28.1 m (+92 ft) Waste 4.0 m
 Water not struck Bedrock 1.0 m+
 Shell and auger 200 mm
 January 1983

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.5	0.5
Glacial Lake Deposits	Clay, dusky yellowish brown; interlaminated with silt, weathered to 1.1 m, soft	1.8	2.3
Till	Clay, moderate brown, silty, stony, firm; pebbles of angular mudstone and rounded Carboniferous sandstone and some Triassic sandstone	1.7	4.0
Mercia Mudstone Group	Siltstone, medium bluish grey, fissile	1.0+	5.0

Surface level +23.5 m (+77 ft)
 Water not struck
 Shell and auger 200 mm
 December 1982

Overburden 0.4 m
 Mineral 6.5 m
 Waste 7.0 m
 Bedrock 0.6 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
Glacial Sand and Gravel	a 'Very clayey' pebbly sand Gravel: fine and coarse Sand: mainly fine, quartz Fines: moderate reddish brown, micaceous silt and clay; sporadic silt bands	2.7	3.1
	b 'Sandy' gravel (sand at base) Gravel: coarse with fine and cobbles; subrounded Carboniferous sandstone with limestone and some ?Triassic siltstone Sand: mainly fine, quartz with lithic grains Fines: moderate reddish brown silt and clay	3.8	6.9
	Clay, very sandy, stony, moderate brown; pebbles and cobbles of subrounded to rounded Carboniferous sandstone with some limestone and ?Triassic siltstone, mudstone	6.5	13.4
	'Very clayey' gravel Gravel: fine and coarse, Carboniferous sandstone, limestone and ?Triassic siltstone/mudstone Sand: fine to coarse, subrounded lithic grains Fines: moderate brown silt and clay	0.5	13.9
Sherwood Sandstone Group	Sandstone, dark reddish brown, fine-grained, with some clay, dark reddish brown with greenish grey spots	0.6+	14.5

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines			Gravel			
					- $\frac{1}{16}$	$+\frac{1}{16}$ - $\frac{1}{4}$	$+\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
a	27	66	7	0.4-1.5	38	42	2	2	8	8	0
				1.5-3.1	20	76	2	1	1	0	0
				Mean	27	63	2	1	4	3	0
b	8	54	38	3.1-5.0	6	18	6	6	13	38	13
				5.0-6.9	10	72	4	1	2	11	0
				Mean	8	45	5	4	7	25	6
	26	20	54	13.4-13.9	26	7	7	6	25	29	0
a+b	16	58	26	Mean	16	51	4	3	6	16	4

SE 47 SW 22 4170 7345 Cundall Lodge

Block D

Surface level +21.4 m (+70 ft)
 Water struck but level not recorded
 Shell and auger 200 mm
 December 1982

Waste 18.4 m
 Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Glacial Sand and Gravel	Clay, moderate brown, very sandy and stony; clasts comprise Carboniferous limestone and sandstone to cobble size, sand is fine quartz	7.1	7.4
	Gravel Gravel: fine and coarse with cobbles; Carboniferous limestone and sandstone with chert Sand: medium and coarse, subangular to subrounded, lithic grains	1.2	8.6
	Clay, moderate brown, very sandy and stony; clasts comprise Carboniferous limestone and sandstone to cobble size, sand is fine quartz	9.8	18.4
Sherwood Sandstone Group	Sandstone, micaceous, moderate reddish brown, hard but friable	0.2+	18.6

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines	Sand		Gravel			
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
4	21	75	7.4-8.6	4	6	4	11	25	40	10

SE 47 SW 23 4388 7402 Crakehill Farm

Block E

Surface level +22.9 m (+75 ft)
 Water not struck
 Shell and auger 200 mm
 December 1982

Waste 9.5 m
 Bedrock 0.5 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Glacial Lake Deposits	Clay, dark yellowish brown with red tinge, weathered to 0.6 m	4.2	4.4
Till	Clay, moderate reddish brown, stony; pebbles of Carboniferous sandstone and limestone	5.1	9.5
Mercia Mudstone Group	Siltstone, very dark red; veins of fibrous gypsum up to 20 mm thick	0.5+	10.0

SE 47 SW 24 4286 7350 Crakehill, Eldmire

Block E

Surface level +18.6 m (+61 ft)
 Water not struck
 Shell and auger 200 mm
 December 1982

Waste 13.7 m
 Bedrock 0.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Glacial Lake Deposits	Clay, dark yellowish brown, very sandy	0.9	1.2
	Clay, moderate brown, firm	1.9	3.1
	Clay, moderate brown, becoming greyish brown with depth, laminated	9.4	12.5
Till	Clay, moderate reddish brown, stony; pebbles of rounded Triassic sandstone, angular fragments of mudstone and rounded pebbles of Carboniferous sandstone and limestone	1.2	13.7
Sherwood Sandstone Group	Sandstone, dark reddish brown, fine-grained, micaceous	0.3+	14.0

SE 47 SW 25 4436 7336 New Mills

Block E

Surface level +24.0 m (+79 ft)
 Water struck at +10.0 m
 Shell and auger 200 mm
 January 1983

Waste 14.0 m
 Bedrock 1.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Glacial Lake Deposits	Clay, dusky yellowish brown, with subvertical medium light grey streaks; firm, stoneless, laminated; weathered to 0.8 m	1.6	1.9
	Clay, greyish red, silty, sandy, stony, firm; clasts comprise granule to cobble, angular and rounded Carboniferous sandstone, angular Triassic sandstone, subangular micaceous black siltstone	4.9	6.8
Till	Clay, greyish brown, silty, stony, soft; abundant subangular granules of Triassic mudstone	2.8	9.6
	Clay, moderate brown; silty, sandy, stony, hard to very hard; clasts as above	0.9	10.5
	Clay, dusky yellowish brown, silty, slightly sandy, stony, firm to hard; subangular to rounded Carboniferous limestone and sandstone up to cobble size predominant	3.5	14.0
Mercia Mudstone Group	Silty sandstone, light bluish grey, fine-grained, very hard	1.0+	15.0

SE 47 SW 26 4092 7234 Town Mouth

Block D

Surface level +15.9 m (+52 ft)
 Water struck at +6.7 m
 Shell and auger 200 mm
 January 1983

Waste 16.1 m
 Bedrock 0.4 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil and made ground	0.6	0.6
Glacial Lake Deposits	Clay, greyish brown, finely interlaminated with greyish orange pink silt, becoming moderate reddish brown near base; weathered to 1.4 m	8.6	9.2
	Sand, medium, subangular to subrounded quartz, moderate reddish brown	0.3	9.5
Glacial Sand and Gravel	Clay, moderate reddish brown, very sandy, stony; pebbles and cobbles of rounded Carboniferous limestone and sandstone	1.7	11.2
	Gravel Gravel: fine and coarse; predominantly rounded and subrounded Carboniferous limestone, sandstone and chert, with quartzite and some Triassic sandstone Sand: medium with some coarse, subrounded quartz and subangular lithic grains Fines: dark yellowish brown silt and clay	1.4	12.6
	Clay, moderate brown, very sandy and stony; fine and coarse pebbles of rounded Carboniferous sandstone and limestone with quartzite; sample graded as mineral but fines were lost during recovery	3.5	16.1
Sherwood Sandstone Group	Sandstone, dark reddish brown, very hard	0.4+	16.5

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines		Sand			Gravel	
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
2	28	70	11.2-12.6	2	7	12	10	36	33	0

SE 47 SW 27 4175 7223 Bat Bridge, Cundall

Block D

Surface level +16.7 m (+55 ft)
 Water struck but level not recorded
 Shell and auger 200 mm
 December 1982

Overburden 4.1 m
 Mineral 4.8 m
 Waste 4.9 m
 Bedrock 0.5 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Glacial Lake Deposits	Clay, medium bluish grey mottled with dark yellowish orange, silty, sandy	0.2	0.4
	'Clayey' sand, fine quartz, strong yellowish orange	0.7	1.1

	Clay, olive grey, silty, laminated	3.0	4.1
Glacial Sand and Gravel	a Sand, mainly fine, quartz with some lithic grains	2.3	6.4
	b Gravel	2.5	8.9
	Gravel: fine and coarse with some cobbles, subrounded Carboniferous limestone and sandstone with some siltstone/mudstone Sand: mainly fine, quartz Fines: moderate brown, silt and clay		
	Clay, sandy, stony	3.3	12.2
Till	Clay, dusky yellowish brown, silty, very sandy, stony, firm; clasts include granules and pebbles of subangular to subrounded Carboniferous sandstone and limestone, with chert and some Triassic sandstone	1.6	13.8
Mercia Mudstone Group	Mudstone/siltstone, dark reddish brown, with greenish grey spots and lenses; gypsiferous, hard	0.5+	14.3

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines			Gravel			
					- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
a	6	93	1	4.1-6.4	6	78	14	1	1	0	0
b	3	47	50	6.4-8.9	3	32	10	5	18	29	3
a+b	5	69	26	Mean	5	54	12	3	10	15	1

SE 47 SW 28	4299 7187	Gravel Hill	Block D
Surface level +22.3 m (+73 ft)			Overburden 1.4 m
Water not struck			Mineral 3.7 m
Shell and auger 200 mm			Waste 5.6 m+
January 1983			

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Glacial Sand and Gravel	Silty sand, with rounded cobbles of Carboniferous sandstone	1.1	1.4
	Gravel	3.7	5.1
	Gravel: fine and coarse, with some cobbles; rounded Carboniferous, sandstone and limestone Sand: fine to coarse, angular; quartz with limestone and chert		
Laminated Clay closely associated with Glacial Deposits	Silt, clay and sand, interlaminated	5.6	10.7
	Borehole abandoned due to operational difficulties		

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines		Sand			Gravel	
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
6	22	72	1.4-2.4	5	11	11	16	31	24	2
			2.4-3.4	2	5	5	9	26	47	6
			3.4-4.4	4	0	16	9	28	37	6
			4.4-5.1	16	1	1	2	36	41	3
			Mean	6	4	9	9	30	38	4

SE 47 SW 29 4381 7212 Fawdington House Block D

Surface level +17.1 m (+56 ft) Overburden 3.1 m
 Water not struck Mineral 1.2 m
 Shell and auger 200 mm Bedrock 0.7 m+
 January 1983

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Till	Clay, stony; 0.2-0.4 m moderate yellowish brown and greenish grey; 0.4-0.6 m moderate brown and medium bluish grey, mottled; 0.6-1.8, moderate reddish brown, streaked with light greenish grey; clasts include abundant subangular to subrounded pebbles and cobbles of Carboniferous limestone and sandstone, Jurassic and Triassic mudstone, <i>Gryphaea incurva</i>	1.6	1.8
Glacial Sand and Gravel	Clayey sand, moderate brown, fine	0.2	2.0
Till	Clay, moderate reddish brown to moderate brown; sandy, silty and stony; clasts comprise subangular to subrounded siltstone, limestone and sandstone	1.1	3.1
Glacial Sand and Gravel	'Clayey' gravel Gravel: coarse and fine, subangular to subrounded limestone, siltstone and sandstone with some chert Sand: mainly fine, lithic and quartz grains	1.2	4.3
Mercia Mudstone Group	Siltstone, greenish grey and moderate reddish brown, hard	0.7+	5.0

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines		Sand			Gravel	
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
10	42	48	3.1-4.3	10	24	12	6	17	31	0

SE 47 SW 30 4452 7204 Spring Cottages **Block E**
 Surface level +22.9 m (+75 ft) Waste 7.3 m+
 Water struck at +19.1 m
 Shell and auger 200 mm
 January 1983

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Glacial Lake Deposits	Clay, dark yellowish brown with oxidation/reduction patches; stoneless, very sandy, soft	1.0	1.3
	Clay, moderate brown, laminated, stoneless, firm	1.3	2.6
	Clay, greyish brown, finely interlaminated with light grey silt and strong yellowish orange sand; stoneless, firm	1.2	3.8
Till	Clay, dusky yellowish brown, very stony and slightly silty, firm; abundant angular to rounded granules of Carboniferous and Triassic lithologies, angular pebbles of micaceous yellow sandstone, quartzite and limestone boulders; below 5.0 m becomes very hard and greyish red with common, rounded Carboniferous limestone and sandstone	3.5+	7.3
Borehole abandoned due to operational difficulties			

SE 47 SW 31 4231 7101 Park Hill **Block D**
 Surface level +22.3 M (+73 ft) Overburden 3.6 m
 Water struck but level not recorded Mineral 5.0 m
 Shell and auger 200 mm Waste 0.7 m
 January 1983 Mineral 4.2 m
Waste 3.2 m
Bedrock 2.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Glacial Sand and Gravel	Silty sand, moderate brown, fine quartz	3.1	3.4
	Clay, moderate reddish brown, sandy, stony, crudely laminated	0.2	3.6
	a 'Clayey' pebbly sand Gravel: fine and coarse Sand: mainly fine, quartz	5.0	8.6
Laminated Clay closely associated with Glacial deposits	Clay, dark reddish brown; silty, laminated; some greenish grey streaks and light brown silt/ very fine sand on bedding planes	0.7	9.3
Glacial Sand and Gravel	b 'Clayey' sand, fine, quartz	4.2	13.5
Till	Clay, moderate brown, sandy, stony; pebbles and cobbles of subrounded Carboniferous sandstone, limestone with some siltstone and quartz; very sandy at 16.0 m	3.2	16.7
Sherwood Sandstone Group	'Clayey' sand, fine to medium quartz, moderate brown	1.6	18.3
	Sandstone, moderate reddish brown, variegated	0.7+	19.0

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages							
	Fines	Sand	Gravel			Fines		Sand			Gravel	
						- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
	43	57	0	0.3-3.4	43	55	2	0	0	0	0	
a	17	76	7	3.6-6.6	20	60	8	1	3	8	0	
				6.6-8.6	14	77	7	1	1	0	0	
				Mean	17	68	7	1	2	5	0	
b	11	89	0	9.3-13.5	11	86	3	0	0	0		
a+b	14	83	3	Mean	14	77	5	1	1	2	0	

SE 47 SW 32 4320 7147 Thornton Bridge

Block D

Surface level +15.8 m (+52 ft)
 Water struck but level not recorded
 Shell and auger 200 mm
 January 1983

Overburden 4.6 m
 Mineral 3.5 m
 Waste 2.1 m
 Mineral 5.6 m
 Waste 3.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
	Made ground	2.8	3.0
Alluvium	Clay, sandy; greyish brown, mottled with strong yellowish orange; dark ?organic patches	1.6	4.6
	a 'Clayey' sandy gravel Gravel: fine and coarse, subrounded Carboniferous sandstone with traces of chert and quartz Sand: fine and medium, lithic and quartz grains Fines: greyish brown sandy clay bands mottled with dark ?organic patches	3.5	8.1
Till	Clay, moderate brown, becoming dark reddish brown; very sandy, stony; clasts include subangular to rounded pebbles of sandstone and limestone, with sporadic siltstone and quartz	2.1	10.2
Glacial Sand and Gravel	b Gravel Gravel: fine and coarse, with some cobble, Carboniferous limestone and sandstone, traces of Palaeozoic mudstone and igneous rocks Sand: fine to coarse, quartz and subangular lithic grains	5.6	15.8
Till	Clay, moderate brown, stony and sandy; pebbles and cobbles of sandstone, limestone, some quartz, siltstone, rare extrusive igneous; hard to very hard; some pebbles of Triassic siltstone below 19.0 m	3.3+	19.1

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines		Sand			Gravel	
					- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
a	11	56	33	4.6-5.8	12	18	14	6	29	21	0
				5.8-6.8	4	20	27	13	27	9	0
				6.8-8.1	16	32	26	11	8	7	0
				Mean	11	24	22	10	21	12	0
b	4	40	56	10.2-11.2	4	10	7	14	36	29	0
				11.2-12.2	5	22	17	14	22	20	0
				12.2-13.2	4	6	10	4	25	51	0
				13.2-14.2	2	11	20	18	24	24	1
				14.2-15.2	2	5	16	28	25	18	6
				15.2-15.8	8	7	13	17	20	28	7
				Mean	4	10	14	16	26	28	2
a+b	7	46	47	Mean	7	16	17	13	24	22	1

SE 47 SW 33 4439 7118 Ewe Hole Lane Block E

Surface level +17.9 m (+59 ft) Waste 25.4 m+

Water not struck

Shell and auger 200 mm

January 1983

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil and made ground	0.6	0.6
Glacial Lake Deposits	Clay, interlaminated with silt, stoneless, firm; dark yellowish brown clay and very pale orange silt to 9.0 m, greyish brown clay and light brown silt/fine sand to 21.6 m; 21.3-21.6 m sporadic subangular lithic granules (?dropstones); weathered to 1.7 m	21.0	21.6
Till	Clay, greyish red, silty, very stony, slightly sandy, soft; abundant angular granules of Triassic lithologies	3.8+	25.4

SE 47 SW 34 4081 7045 Broom Close House Block D

Surface level +22.9 m (+75 ft) Overburden 1.0 m

Water not struck Mineral 1.6 m

Shell and auger 200 mm Waste 2.5 m

January 1983 Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Glacial Lake Deposits	Clay, dark yellowish brown, laminated, stoneless, firm	0.8	1.0
	'Clayey' sand	1.6	2.6
	Sand: mainly fine, subangular to rounded, quartz		
	Fines: moderate reddish brown silt and clay		

Till	Clay, greyish brown, very sandy and stony, firm; clasts up to cobble size Carboniferous sandstone, limestone and chert; below 4.0 m becomes very hard	2.5	5.1
Sherwood Sandstone Group	Sandstone, dark reddish brown, fine-grained, micaceous, very hard	0.1+	5.2

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				- $\frac{1}{16}$	+ $\frac{1}{16}$ - $\frac{1}{4}$	+ $\frac{1}{4}$ -1	+1 -4	+4 -16	+16 -64	+64 mm
12	88	0	1.0-2.6	12	80	8	trace	0	0	0

SE 47 SW 35	4314 7013	Treblesyke	Block D
Surface level +22.1 m (+73 ft)			Waste 19.7 m
Water struck at +3.5 m			Bedrock 0.3 m+
January 1983			

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.6	0.6
Laminated Clay closely associated with Glacial Deposits	Clay, variegated, moderate brown and medium dark grey; rare fine pebbles; interlaminated with silt; with depth, clay becoming greyish brown and silt moderate reddish brown	6.7	7.3
Glacial Sand and Gravel	Sand, fine and medium, quartz with some lithic grains	1.2	8.5
	Clay with sand and silt bands, moderate reddish brown, stony and sandy; some crude lamination	3.2	11.7
	Sand, fine, with some medium; quartz, some medium lithic grains; moderate reddish brown fines	3.1	14.8
Till	Clay, moderate brown, sandy and stony; Carboniferous sandstone and limestone clasts predominant	3.8	18.6
	'Clayey' sand and sandstone fragments, moderate reddish brown, fine-grained	1.1	19.7
Sherwood Sandstone Group	Sandstone, fine-grained, moderate reddish brown	0.3+	20.0

Surface level +15.1 m (+50 ft)
 Water struck at +11.1 m
 Shell and auger 200 mm
 January 1983

Overburden 0.3 m
 Mineral 11.5 m
 Waste 0.8 m
 Mineral 4.9 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Alluvium	a 'Very clayey' sand Sand: mainly fine, subangular to subrounded, quartz with some lithic grains Fines: dark yellowish brown silt and clay to 4.6 m, olive grey below; organic traces throughout	7.2	7.5
Glacial Sand and Gravel	b Gravel Gravel: coarse and fine, with some cobble; Carboniferous sandstone with limestone, some chert and traces of Triassic sandstone and mudstone, quartz and Palaeozoic mudstone Sand: mainly coarse, subangular to subrounded lithic grains with quartz; finer with depth Fines: dark yellowish brown silt and clay	4.3	11.8
	Silt, sandy, micaceous, firm, greyish red	0.4	12.2
Till	Clay, greyish red, silty and sandy, stony, very hard; abundant granules of subangular Carboniferous and Triassic lithologies	0.4	12.6
Glacial Sand and Gravel	c Gravel Gravel: coarse, with fine and some cobble; Carboniferous sandstone and limestone with traces of Magnesian Limestone, chert, Triassic sandstone and mudstone and igneous rocks Sand: fine to coarse, subrounded quartz Fines: light brown silt and clay	4.9+	17.5

Borehole abandoned due to operational difficulties

GRADING

	Mean for deposit percentages			Depth below surface (m)	Percentages						
	Fines	Sand	Gravel		Fines			Gravel			
					- $\frac{1}{16}$	$+\frac{1}{16}$ - $\frac{1}{4}$	$+\frac{1}{4}$ - 1	+1 - 4	+4 - 16	+16 - 64	+64 mm
a	26	74	0	0.3-1.3	30	58	12	0	0	0	0
				1.3-2.3	25	50	25	0	0	0	0
				2.3-4.6	18	40	42	0	0	0	0
				4.6-5.6	26	51	23	0	0	0	0
				5.6-6.6	33	53	14	0	0	0	0
				6.6-7.5	39	53	8	0	0	0	0
				Mean	26	50	24	trace	0	0	0
b	3	44	53	7.5-8.5	4	10	14	36	26	10	0
				8.5-9.5	5	22	14	22	13	24	0
				9.5-10.4	No grading data available						
				10.4-11.8	1	7	6	10	18	52	6
				Mean	3	12	10	22	19	32	2
c	4	30	66	12.6-14.1	5	4	3	5	24	59	0
				14.1-15.0	5	6	7	17	31	32	2
				15.0-16.0	2	9	6	5	14	55	9
				16.0-17.5	5	30	10	15	14	26	0
				Mean	4	13	7	10	20	44	2
a+b+c	14	53	33	Mean	13	29	15	9	11	21	1

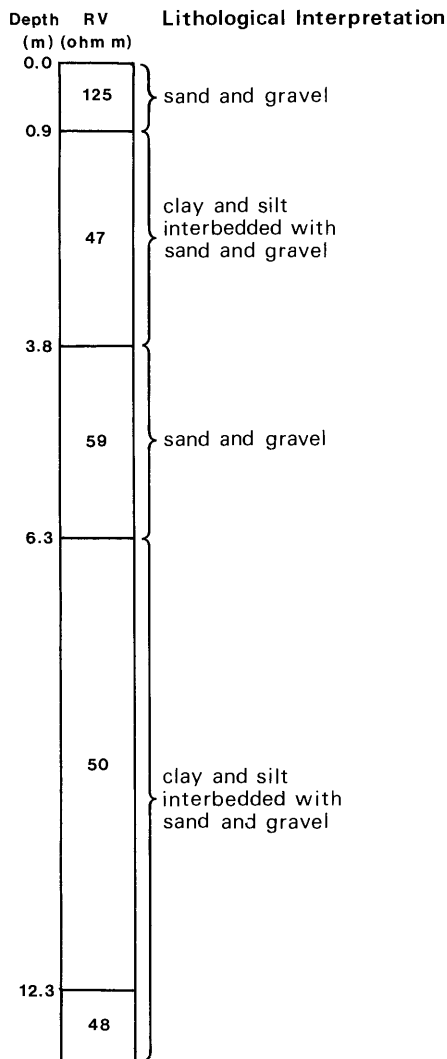
APPENDIX F
Shallow Resistivity Survey

Twelve resistivity depth soundings were conducted at six sites to augment the drilling programme undertaken for this assessment. The soundings were made using the Offset-Wenner multi-core cable system in conjunction with the ABEM SAS 300 Digital Terrameter with booster. The application of this system to the investigation of shallow drift deposits was originally tested in 1982 in the Henley-in-Arden district of Warwickshire, where resistivity soundings were carried out on a larger scale (Clarke and others, 1982, unpublished internal report No. 82/1; Cannell and Crofts 1984). The processing of the apparent resistivity values was carried out using a field-based micro-computer interpretation programme which produced listings of the field data together with 'best-fit' interpretations based on the iterative generation of geo-electric curves and plots for each sounding. Lithological assessments of these data are given in Figures 10 to 14.

By comparing the results obtained from the present district with those from the Henley-in-Arden feasibility

studies, it is considered that, in general, high resistivity values (over 70 ohm m) are indicative of sands and gravels, or of a sandy bedrock. Similarly, low resistivity values (less than 40 ohm m) have been assumed to indicate clays or a clayey bedrock. Intermediate resistivity values (40 to 70 ohm m) need very careful evaluation in the light of the likely lithostratigraphy demonstrated by nearby boreholes and consideration of the geological possibilities: such readings may indicate sands interbedded with clays and silts, and in the Ripon district, they may represent glacial lake deposits, glacial sand and gravel with interbedded clays, till or a combination of these deposits. Further investigations, involving comparisons with borehole check sampling, would be required to obtain a more complete understanding and accurate interpretation of these intermediate resistivity values.

RI 1.1 (3928 7644) c.20m AOD



RI 1.2 (3924 7652) c.20m AOD

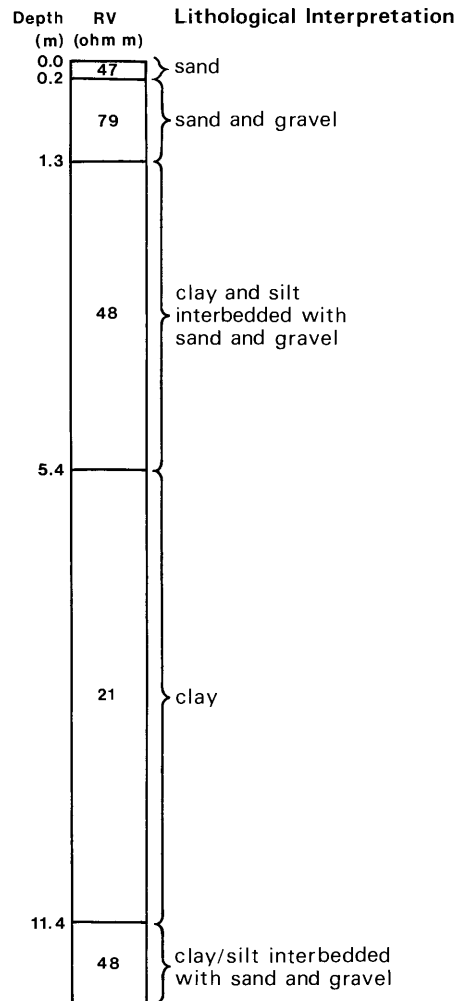


Figure 10 Lithological interpretation of two resistivity soundings at Topcliffe Mill, Topcliffe.

For each sounding (left-side of figure), the resistivity value (RV) in ohm-metres and inferred depth in metres to the base of each resistivity layer are interpreted (right-side of figure) in terms of the likely lithology of each layer. Each sounding on the Ripon project is identified by the letter RI followed by the site number, the sounding number at that site and the National Grid Reference of its centre point in square brackets; the full reference for the second sounding at the first site is RI 1.2 [3924 7652]. The estimated height above ordance datum is also shown.

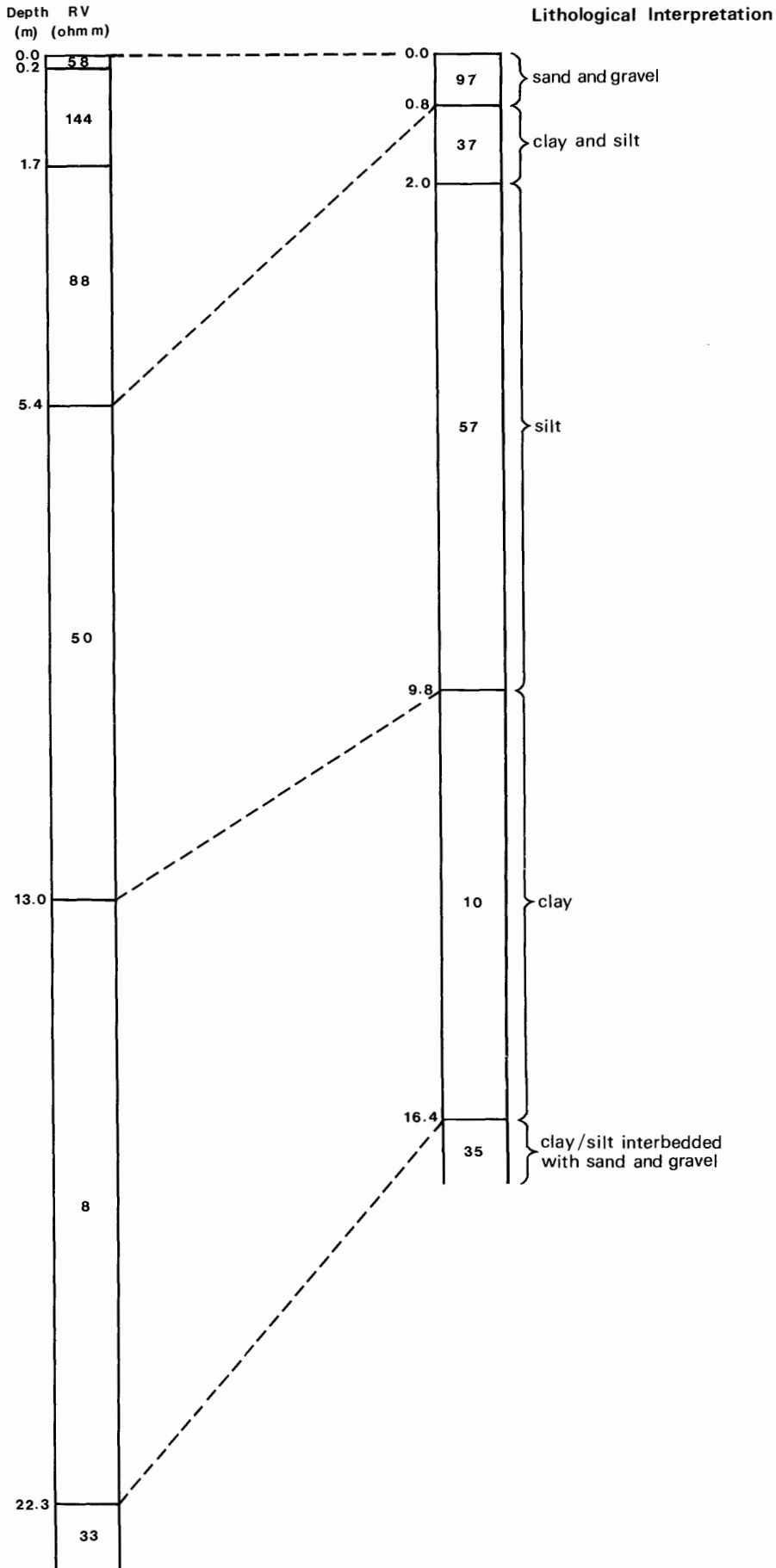


Figure 11 Lithological interpretation of two resistivity soundings at Far Ings, Cundall (for explanation see Figure 10).

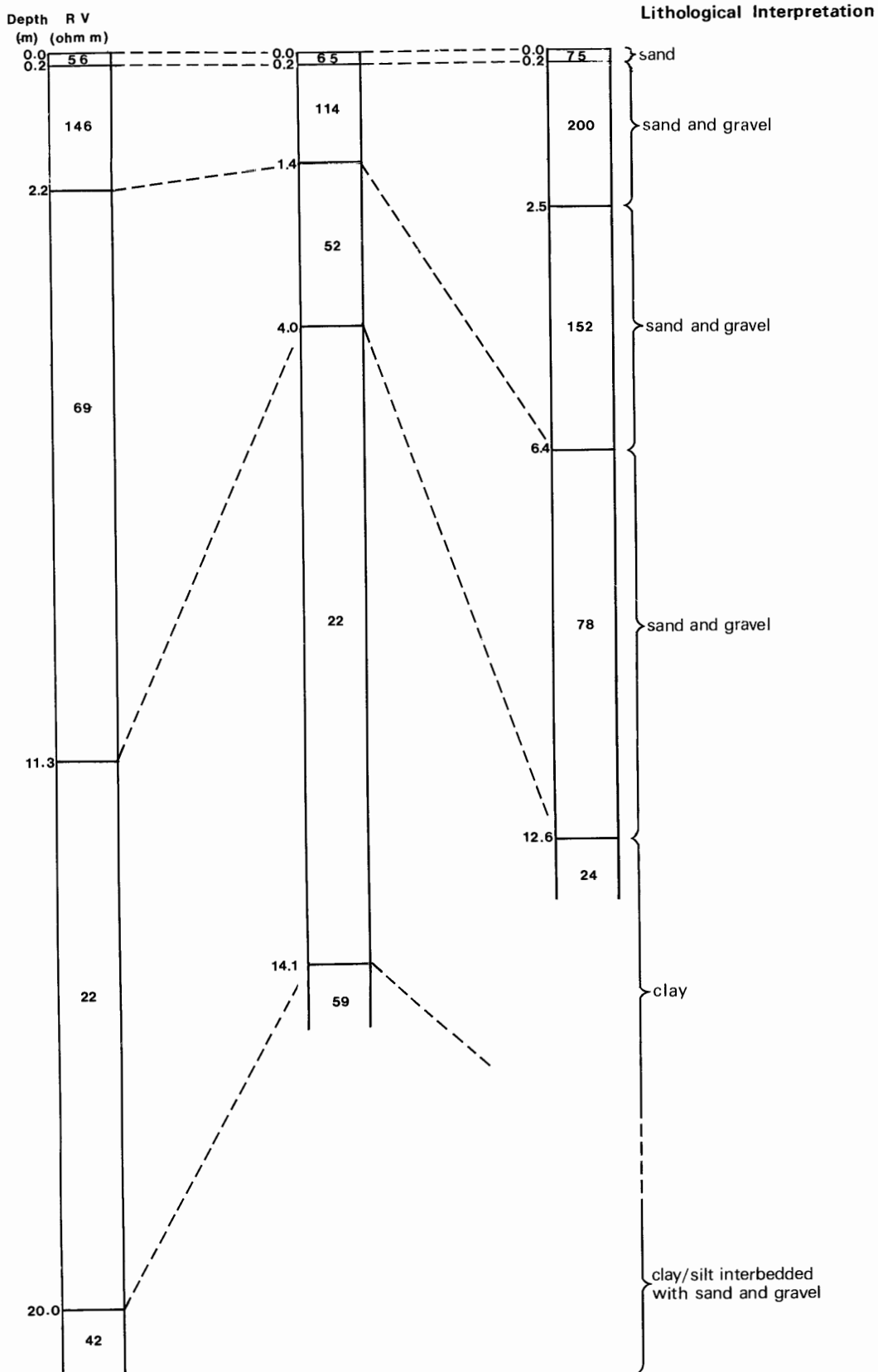
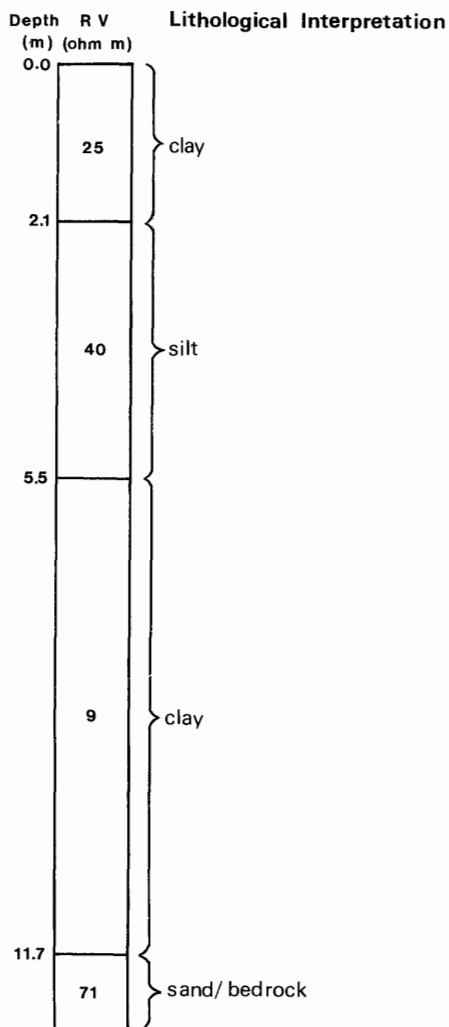
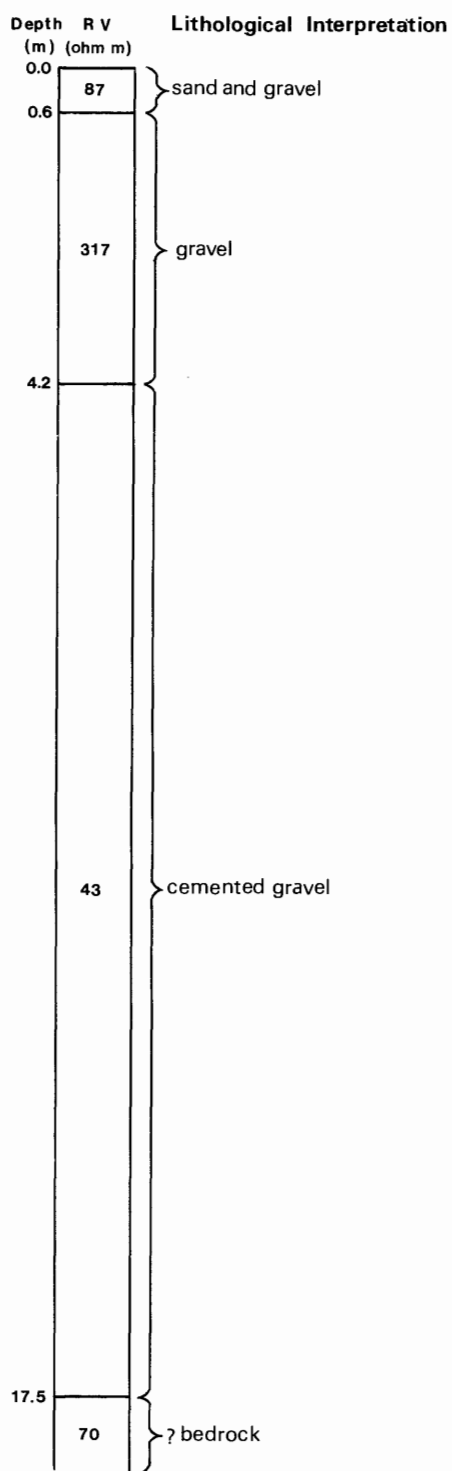


Figure 12 Lithological interpretation of three resistivity soundings at Eldmire (for explanation see Figure 10).



(a)



(b)

Figure 14 Lithological interpretation of: a) a resistivity sounding at Richmond Farm, Topcliffe b) a resistivity sounding at Ure Bank, Ripon (for explanation see Figure 10).

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THE SAND AND GRAVEL RESOURCES OF THE COUNTRY NORTH-EAST OF RIPON, NORTH YORKSHIRE

Scale 1:25 000 or about 2 1/2 Inches to 1 Mile

ORDNANCE SURVEY
SHEET SE 37 & part of SE 47
PROVISIONAL EDITION

EXPLANATION OF SYMBOLS AND ABBREVIATIONS

- DRIFT**
- Peat P-1
 - Alluvium-silt, clay, gravel and sand A-51
 - River Terrace Deposits, undifferentiated-gravel with sand; some beds of silt and clay RT-37
 - Blown Sand-silty fine sand BS-14
 - Sand-clayey sand, some gravel S-5
 - Silt and Clay-laminated silt and clay; some sand SI-8
 - Fluvio-glacial Terrace Deposits, undifferentiated-sand and gravel FL-5
 - Fluvio-glacial Sand and Gravel-pebbly sand, with a few boulders, and gravel FL-34
 - Laminated Clay closely associated with Glacial Deposits-sandy and laminated clay LC-9
 - Glacial Sand and Gravel-clayey and very clayey sand to gravel and sandy gravel, with some beds of silt and clay GS-93
 - Sandy Till-sandy clay, stony in part; some beds of sand, gravel and silt SAT-3
 - Till-stony clay, sandy and silty matrix in part; some beds of sand, gravel and silt TL-24
 - Sand and Gravel of unknown age (in buried valleys)-gravel, sandy gravel and sand; some silt and clay partings SG-7

- SOLID**
- Undivided (see Figure 3 of the Report)
 - Made Ground MG-2
 - Areas worked for Sand and Gravel, or quarries WO-26

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

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

- I.M.A.U. BOREHOLES**
- Borehole Registration Number 37 NE 47
- Borehole site 28
- Geological Classification 4-8
- Waste from mineral 4-8
- Geological Classification 4-8
- Grading Diagram
- Thicknesses in metres

Note:
(i) Figures underlined denote thicknesses used in the assessment of resources
(ii) The + sign indicates that the base of the deposit was not reached
(iii) The Geological Classification is given only for mineral and bedrock
(An explanation of the bedrock symbols is given in Figure 3 of the report)

Borehole Registration Number
Each I.M.A.U. borehole is identified by a Registration Number, e.g. 37 NE 47. The first number and letters refer to the quarter sheet and the second number to the B.G.S. serial number for that quarter. The unique designation for borehole 37 NE 47 is SE 37 NE 47.

Grading Diagrams
Each grading diagram shows the mean particle size distribution of a distinct deposit of mineral.
The height of the diagram is proportional to the mineral thickness.
The widths of the divisions show the proportions of fines, sand and gravel, but small amounts of gravel may be omitted or exaggerated.

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

EXPOSURE RECORDS
Information from the inspection of exposures is shown in the same way as for boreholes, but they are located by an asterisk, thus: * They are registered in their own series and have the prefix E.

GEOPHYSICAL DATA

SITE LOCATIONS

- Resistivity Depth Sounding

RESISTIVITY DEPTH SOUNDINGS

Depth Sounding Identification Number RI 4.3

Geological Classification 4-8

Note:
(1) The Depth Sounding Identification Number comprises a two-letter abbreviation of the sheet name, viz. RI, followed by the Site Serial Number for the sheet and the sounding number, thus RI 4.3 is the third sounding at Site 4 on this sheet.
(2) The figures represent the thicknesses, in metres, of deposits interpreted from the resistivity data.
(3) Other conventions are the same as for I.M.A.U. boreholes.

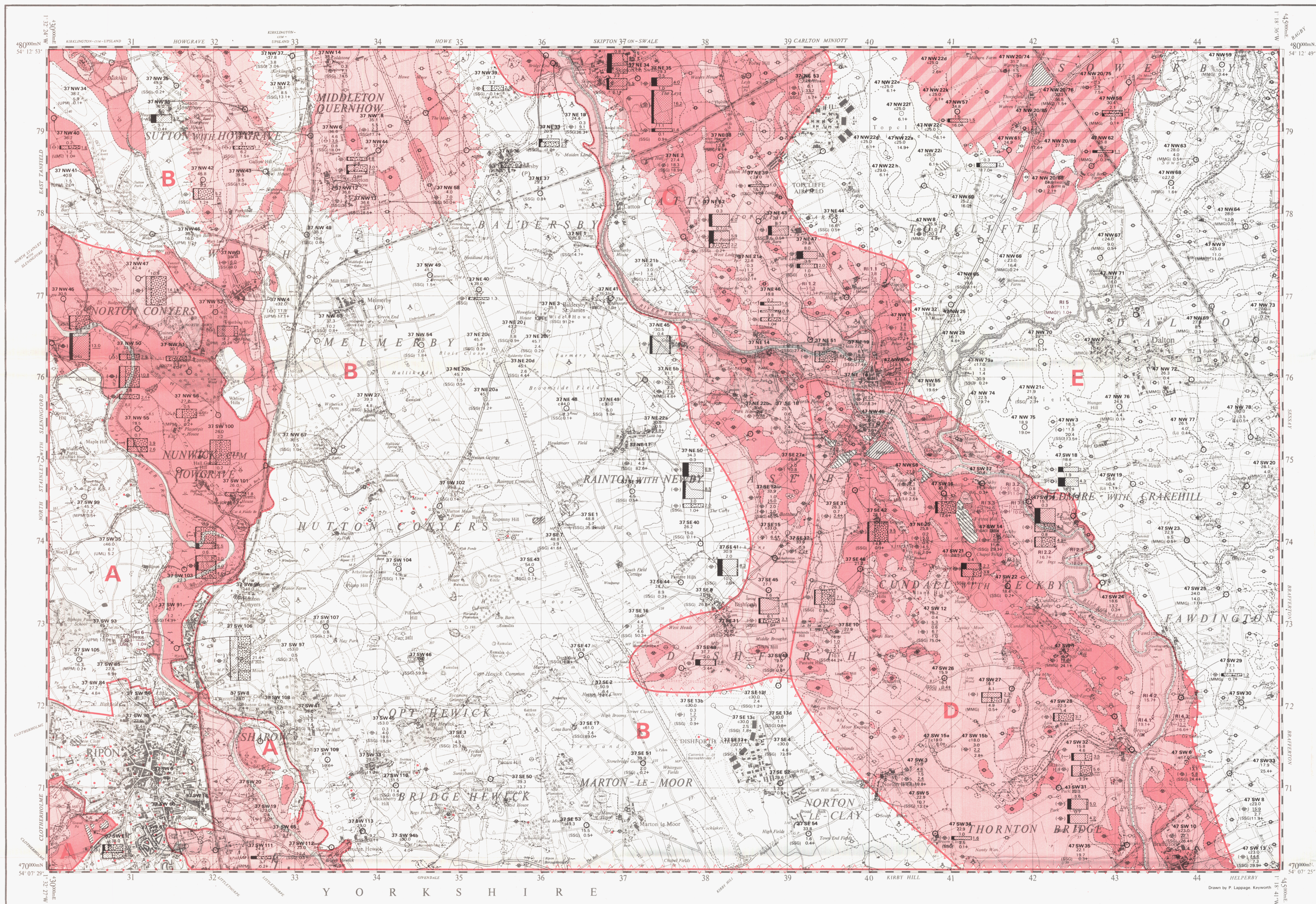
- CATEGORIES OF DEPOSITS**
- Exposed mineral CAT-EG
 - Exposed mineral, and continuous or almost continuous spreads of mineral beneath overburden, undifferentiated CAT-E11
 - Continuous or almost continuous spreads of mineral beneath overburden CAT-C1
 - Sand and gravel either not potentially workable (see Report) or absent CAT-A2
 - Sand and gravel not assessed CAT-N1

RESOURCE BLOCKS

For the purpose of assessment, the map is divided into Resource blocks. Each block is designated by a letter.

Detailed records may be consulted on application to the Officer in Charge (PD-B), British Geological Survey, Nicker Hill, Keyworth, Nottingham, NG12 5GG.

Compiled and produced by the Keyworth Drawing Office
British Geological Survey.



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 six-inch surveys by A.C. Benfield, A.H. Cooper, C.G. Godwin, H. Johnson and J.H. Powell in 1917-78 and 1980-82; E.G. Smith and J.L. Chisholm, District Geologists.

Sand and Gravel Survey by A.N. Mengi, D. Thomas, J.R.A. Giles and L. Jackson in 1982-83. R.G. Thwaites, Head, Industrial Minerals Assessment Unit.

1:25 000 Sand and Gravel Resource Sheet published 1984 G.M. Brown, D.Sc., F.R.S., Director, British Geological Survey.

Scale 1:25000
Yards 1000 0 1000 2 Miles
Metres 1000 0 1000 2 Kilometres

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

1 square inch on this map represents 99439 acres on the ground.

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

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Compiled from 6" sheets last fully revised 1907-28. Other partial systematic revisions 1938-51 have been incorporated. Major roads revised 1969-78. The map and the accompanying report were commissioned and financed by the Department of the Environment.

Made and published by the Ordnance Survey, Southampton. Reprinted with some minor changes and some new major roads 1970.

Down by P. Lappage, Keyworth.

Diagram showing the relationship of this sheet to the National Grid 1:25 000 sheets and the New Series One-inch Geological Sheets 51, 52, 61 and 62.

SE 28	SE 38	SE 48
51	52	53
SE 27	SE 37	SE 47
51	52	53
SE 26	SE 36	SE 46
51	52	53