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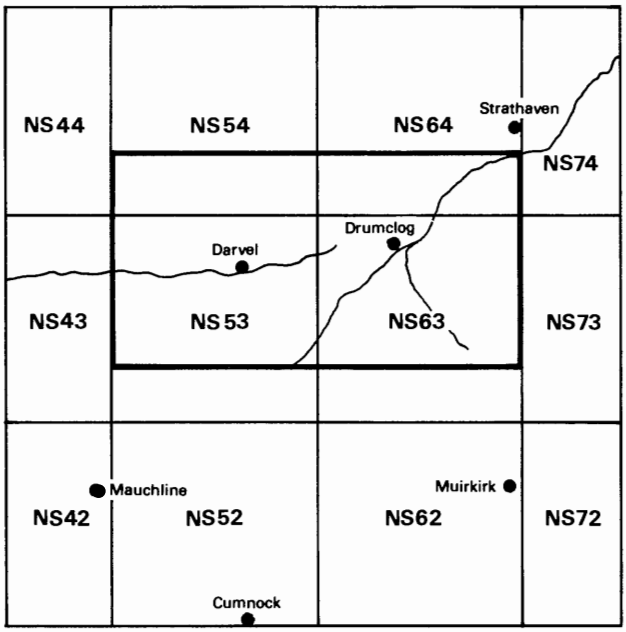

The sand and gravel resources of the country around Darvel, Strathclyde

Description of parts of 1:25 000 sheets NS 53, 54, 63 and 64

E. F. P. Nickless, A. M. Aitken and A. A. McMillan

With contributions by P. Stone and G. H. Collins

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

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The asterisk on the front cover indicates that parts of NS 53/63 and parts of sheets immediately to the north are described in this Report.

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, which have been extended progressively through Central and Northern England. Work in Scotland, which began in 1975, is being financed by the Department of the Environment, acting through the Scottish Development Department and is being undertaken with the cooperation of the Sand and Gravel Association of Great Britain.

This report describes the resources of sand and gravel of 194.9 km^2 of country around Darvel, Strathclyde Region, shown on the accompanying resource map. The survey was conducted by A. M. Aitken and A. A. McMillan under the supervision of E. F. P. Nickless, assisted in the drilling and sampling programme by D. P. Best, A. M. Harrisson, J. H. Lovell and J. W. Merritt. The work, which was controlled from the sub-unit in Edinburgh (E. F. P. Nickless, Officer-in-Charge) is based on one-inch geological surveys of Sheets 22 and 23, published respectively in 1870 and 1872, and the resurvey conducted between 1912 and 1925. The geological lines, now presented at the 1:25 000 scale, include a re-appraisal of the drift geology by P. Stone and A. D. McAdam based on field surveys during 1976.

The section of the report on the geology of the area is based on notes prepared by P. Stone. A note by G. H. Collins on the petrography of +16 mm material is included as Appendix G. J. W. Gardner, CBE (Land Agent) has been responsible for negotiating access to land for drilling. The ready cooperation of land owners, tenants and gravel companies, the advice of the Building Research Establishment, particularly A. G. Edwards, and the assistance of officials of East Kilbride, and Kilmarnock and Loudoun Districts is gratefully acknowledged.

Austin W. Woodland
Director 21 July, 1978

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Plate 1. Loudoun Hill [6088 3790] , Darvel, from the south. A prominent volcanic plug of Carboniferous age dominates the landscape. Terraced deposits of glacial sand and gravel are worked (middle distance) in close proximity to the hill. (MNS 2149)

Plate 2. Glengavel [658 352] , Strathaven, looking north. Alluvial floodplain deposits form the low flat ground (centre right). Laigh Plewland section (left) exposes some 45 m of glacial deposits and a seepage line approximately one-third up the face marks the contact between glacial sand and gravel above boulder clay. (D 2295)

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SUMMARY

The geological maps of the Institute of Geological Sciences, pre-existing borehole information, eighty-seven boreholes drilled for the Industrial Minerals Assessment Unit, together with data from three working pits and four natural sections, form the basis of the assessment of sand and gravel resources in the Darvel area, Strathclyde.

All deposits in the area which might be potentially workable for sand and gravel have been investigated and a simple statistical method 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 six resource blocks. Statistical assessments are offered for five blocks which contain between 2.2 and 6.8 km^2 of potentially workable sand and gravel. A sixth resource block is inferred to contain 1.6 km^2 of mineral. For the blocks assessed statistically the geology of the deposits is described and the mineral-bearing area, the mean thickness of overburden and mineral, and the mean grading of the various types of deposit are stated. Detailed borehole and section data are given. The geology and the outlines of the resource blocks, the position of boreholes and natural sections considered in the assessment are shown on the accompanying 1:25 000 scale resource map.

Bibliographic reference

NICKLESS, E.F.P., AITKEN, A.M. and McMILLAN, A.A. 1978. The sand and gravel resources of the country around Darvel, Strathclyde. Description of parts of 1:25 000 sheets NS 53, 54, 63 and 64. Miner. Assess. Rep. Inst. Geol. Sci., No 35.

INTRODUCTION

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

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

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

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

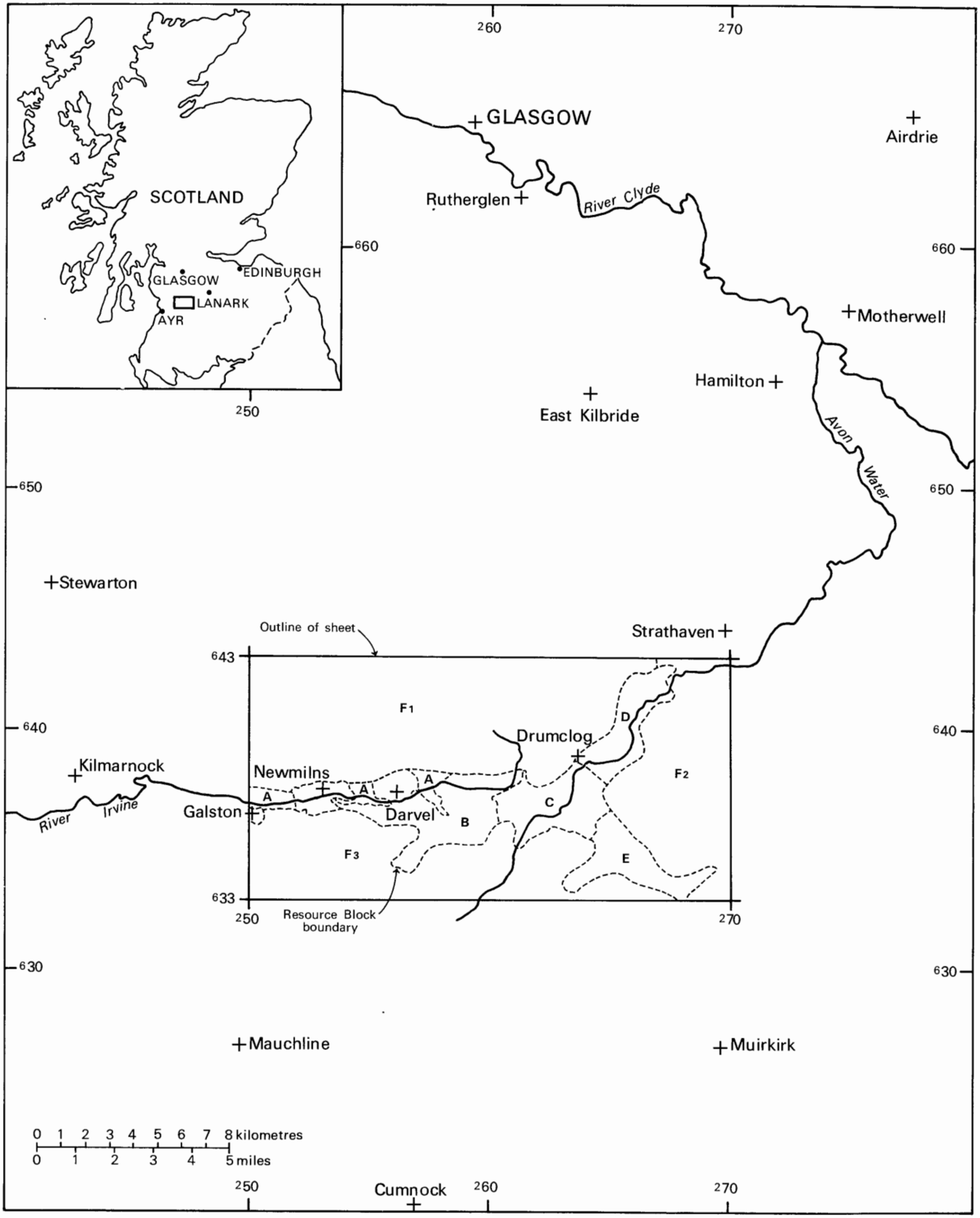


Fig. 1. Sketch-map showing the location of the Darvel area and the position of the resource block boundaries

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

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

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

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

DESCRIPTION OF THE RESOURCE SHEET

GENERAL

The area assessed (Figure 1) covers 194.9 km^2 (about 75 $miles^2$) of country around Darvel, Strathclyde Region, of which 22.8 km^2 or 12 per cent are gravel-bearing. By road, Darvel is situated 42 km south-east of Glasgow, and 87 km south-west of Edinburgh: Kilmarnock lies 14 km to the west and Strathaven 18 km to the east.

The principal objective of this work is to assess the mineral content of the glacial sand and gravel and alluvial deposits, which occur mainly in the Irvine and Avon valleys. Statistical assessments (Appendix B) are offered for these areas, which constitute five resource blocks. A sixth resource block (block F) includes patches of sand and gravel for which assessments are inferred. The burghs of Galston, Newmilns and Greenholm, and Darvel are not assessed.

The area has been an important source of aggregate for many years. Although Glasgow continues to be the principal market, recently concrete oil-production platform construction on the Firth of Clyde coast has stimulated demand.

TOPOGRAPHY

The valleys of the Irvine and Avon constitute the major physiographic feature of the area, which otherwise comprises rolling moorland. Much of the extensively peat-covered upland lies over 215 m (700 ft) above Ordnance Datum, Dungavel Hill [6755 3544] at 457 m (1500 ft) above Ordnance Datum being the highest in the district.

The prominent volcanic plug of Loudoun Hill [6088 3790] sits astride the major watershed separating the westward-flowing Irvine from the easterly-draining Avon, both rivers being misfits. The major tributaries of the Irvine are the Gower Water and Glen Water: the Glengavel Water and Calder Water feed the Avon.

Extensive terraces of glacial sand and gravel characterise the principal valleys and are best developed at Allantonplains [617 371] near Loudoun Hill. Areas of moundy topography (kames) occur locally on the valley sides, and long sinuous ridges (eskers) are found on higher ground.

GEOLOGY

The resource assessment area, which is included in the one-inch Geological sheets 22 (Kilmarnock) and 23 (Hamilton), was originally geologically surveyed at a scale of six inches to one mile by Sir A. Geikie, J. Geikie and B.N. Peach and the maps published in 1870 and 1872 respectively. The area was resurveyed between 1912 and 1925 by E.M. Anderson, E.B. Bailey, R.G. Carruthers, C.H. Dinham, A.G. MacGregor, J. Phemister, J.E. Richey and G. Ross. In connection with the present survey the drift geology was partially resurveyed by P. Stone and A.D. McAdam during 1976.

SOLID

On the resource map accompanying this report, bedrock is undifferentiated. The distribution and classification of the solid rocks, which range in age from Silurian to Tertiary, are summarised in Figure 2.

The oldest rocks exposed are red and purple Ludlovian sandstones of the Lesmahagow inlier, which crop out south-east of the River Avon. They are quartzose, locally rich in feldspar, and have a regional dip of approximately 20° towards the north-west. The Lower Old Red Sandstone overlies the Ludlovian with apparent conformity and is composed of an upward sequence of basal conglomerate, feldspathic sandstones and basalt or andesite lavas. Upper Old Red Sandstone quartzose sandstones overlying Lower Old Red Sandstone lavas, and sandstones and shales of the Carboniferous Limestone Coal Group form outliers south of Newmilns. The diorite and granodiorite stock of the Distinkhorn complex, intruded in late Lower Old Red Sandstone times, has thermally altered the surrounding sediments.

The eastward continuation of the Inchgotrick Fault truncates the Lower Palaeozoic outcrop and downthrows to the north Carboniferous rocks ranging from Calciferous Sandstone Measures to Coal Measures. The former are mainly represented by trachytes and microporphyritic basalts, part of the Upper Group of the Clyde

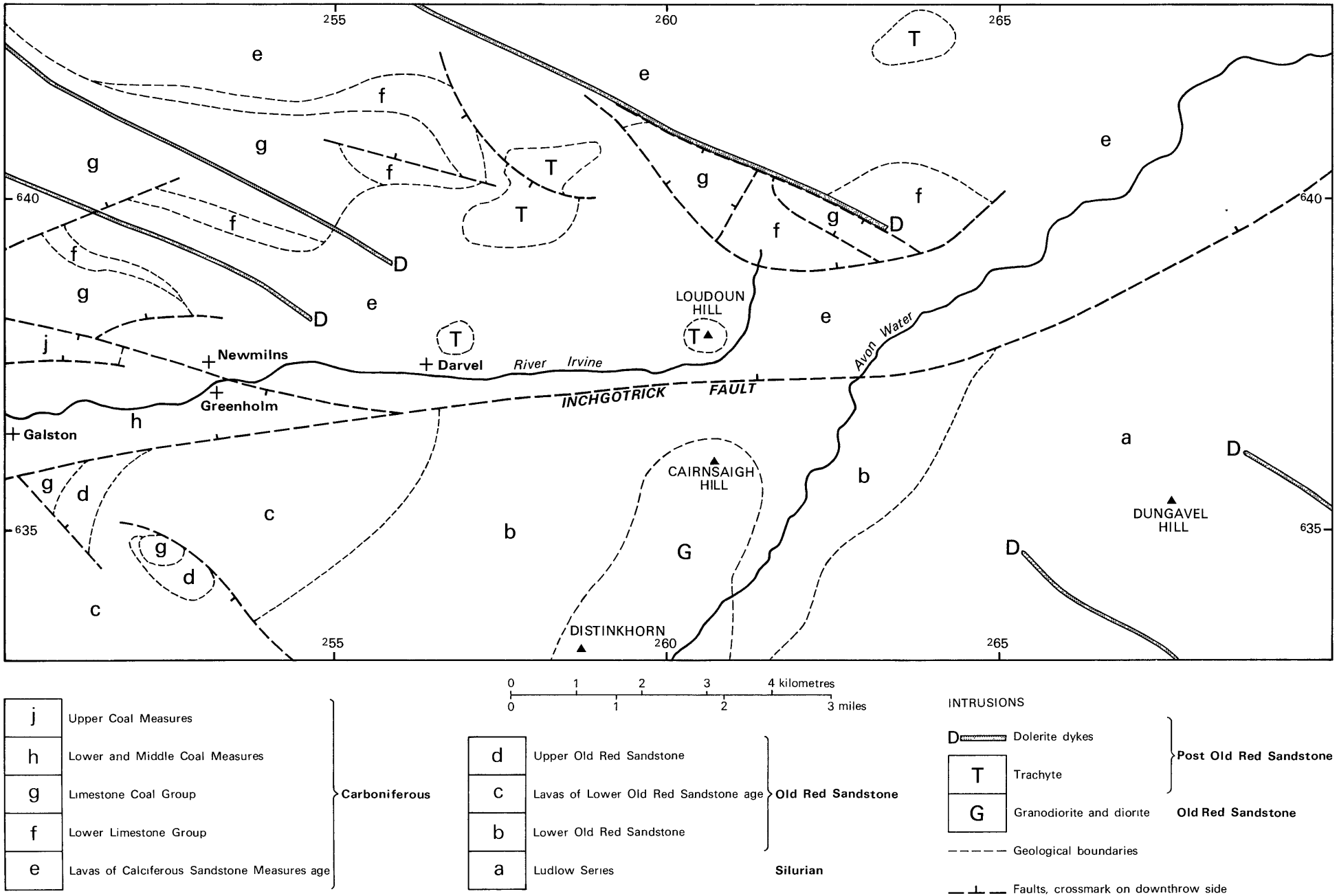


Fig. 2. Sketch-map showing the solid geology of the Darvel area

Plateau Lavas, and are overlain by a thin development of interbedded mudstone, tuff and volcaniclastic conglomerate, which may represent a marginal facies of the Lower Limestone Group. Sandstone, shale and limestone of the Limestone Coal Group overlie this interbedded sequence in the Glen and Muck Water valleys north of Darvel. Folding and faulting have preserved outliers of Carboniferous sediments within the Clyde Plateau Lava outcrop. The prominent volcanic plug of Loudoun Hill is one of several small intrusions of Lower Carboniferous trachyte.

Pale grey sandstones, shales and coals of the Lower and Middle Coal Measures are preserved in a fault-bounded wedge to the west of Darvel. They are overlain conformably in places by reddish sandstones and marls of the Upper Coal Measures.

The youngest rocks exposed in the area are a few north-west trending dykes of post-Old Red Sandstone age.

DRIFT

The distribution and classification of the exposed major drift deposits are summarised in Figure 3.

The area was subjected to glacial activity on several occasions during the Pleistocene. However, the bulk of remaining glacial deposits, including boulder clay, glacial lake deposits and sand and gravel, date from the last major glacial advance in west-central Scotland, possibly complete before 12 500 years BP (Sissons, 1974). Ice originating in the Highlands advanced eastwards along the Irvine-Avon valley, whilst ice from the Southern Uplands at times overwhelmed high ground to the south (McLellan, 1969) breaching the col at the head of Glengavel. Although Dungavel Hill and Distinkhorn [5863 3317] 384 m (1259 ft) may have been covered only briefly by ice, the remainder of the area was probably buried for a substantial period.

Landform and sediments indicate a gradual retreat of ice from the area, the ice sheet becoming inactive at an early stage of deglaciation and stagnating. In general the higher ground became free of ice first, while ice continued to occupy the lower ground of the Irvine-Avon valley, interrupting drainage and creating a succession of temporary glacial lakes in which laminated clays and silts were deposited. The widespread distribution of glacial lake sediments permits an interpretation of the history of glacial wasting and retreat.

Clays, with lamination dipping to the south-east, are exposed in the banks of the Gower Water at Bransfield Bridge [5818 3696] and possibly constitute some of the earliest glacial deposits known in the area. These deposits may have developed in a pro-glacial lake occupying the eastern valley of the Irvine but were deformed subsequently, possibly by overriding ice, and buried beneath gravel and boulder clay. The origin of a basal gravel below boulder clay proved in boreholes 64 SE 5 and 64 SE 8 near Ryeland Bridge [6588 4012] is obscure but possible interpretations are that the deposit is of pre-glacial alluvial origin, pro-glacial outwash of advancing ice or the product of an earlier glaciation.

Patches of sand and gravel occur at heights of up to 305 m (1000 ft) above Ordnance Datum in the valley of the Powbrone Burn [680 339] (McLellan, 1967), but the most extensive deposits occupy the Irvine-Avon valley. With the possible exception of sinuous eskers generally found on ground in excess of 125 m (410 ft) above Ordnance Datum (for example, Shinny Hill [5254 3525]) sand, gravel and associated clays are considered to be the products of glacial stagnation and retreat.

At an early stage of deglaciation water was ponded in the valley of the Powbrone Burn where outwash sand and gravel accumulated. With further down-wasting, drainage became increasingly disrupted and water was at times impounded in Glengavel, creating a series of temporary lakes fed by braiding meltwater streams charged with glacial debris, which now forms kame terraces. Interbedded laminated silts and clays mark quieter hydraulic conditions in a generally highly active depositional environment. The complexity of kame-terrace levels on opposite sides and along the length of Glengavel implies that drainage was marginal to ice occupying the valley-centre and connected with a series of at least six sub-parallel drainage channels, which contour the north-west slope of Hawkwood Hill [6838 3810] between 230 m (755 ft) and 290 m (950 ft) above Ordnance Datum. Meltwater presumably found an outlet into the valley of the Clyde.

The next stage of deglaciation recognised is marked by the formation of a series of lakes lateral to ice in upper Avondale. Sediment was deposited to a height of 215 m (705 ft), the fine sands, silts and laminated clays formed initially being covered by coarser material as the lakes infilled. Throughout the headwater area of the Irvine and Avon, and westward to Changue Glen [578 360] and the valley of the Glen Water, concordance of terrace levels about 215 m (705 ft) suggests the existence of an extensive fluvial system.

With continued melt, upper Avondale became progressively ice-free. However, residual ice occupied the ground between Loudoun Hill and Cairnsaigh Hill [6100 3618] and formed the western limit to a lake in which lacustrine sediments accumulated to a level of 190 m (625 ft) above Ordnance Datum. The eastward limit of the lake is uncertain, but the presence of laminated silts to the east of Drumclog indicates a minimum extent in that direction. Sediment-laden meltwater, flowing into the lake off ice occupying the valley of the Irvine, built up an extensive delta in the vicinity of Loudoun Hill to a height of at least 207 m (680 ft) above Ordnance Datum (Plate 1). Smaller deltas formed penecontemporaneously in other parts of the lake. An easterly drainage was maintained as the lake level dropped, presumably in response to the gradual withdrawal of ice from the valley of the Clyde causing dissection of the deltaic deposits to form extensive terraces of sand and gravel. An alternative explanation for the formation of the

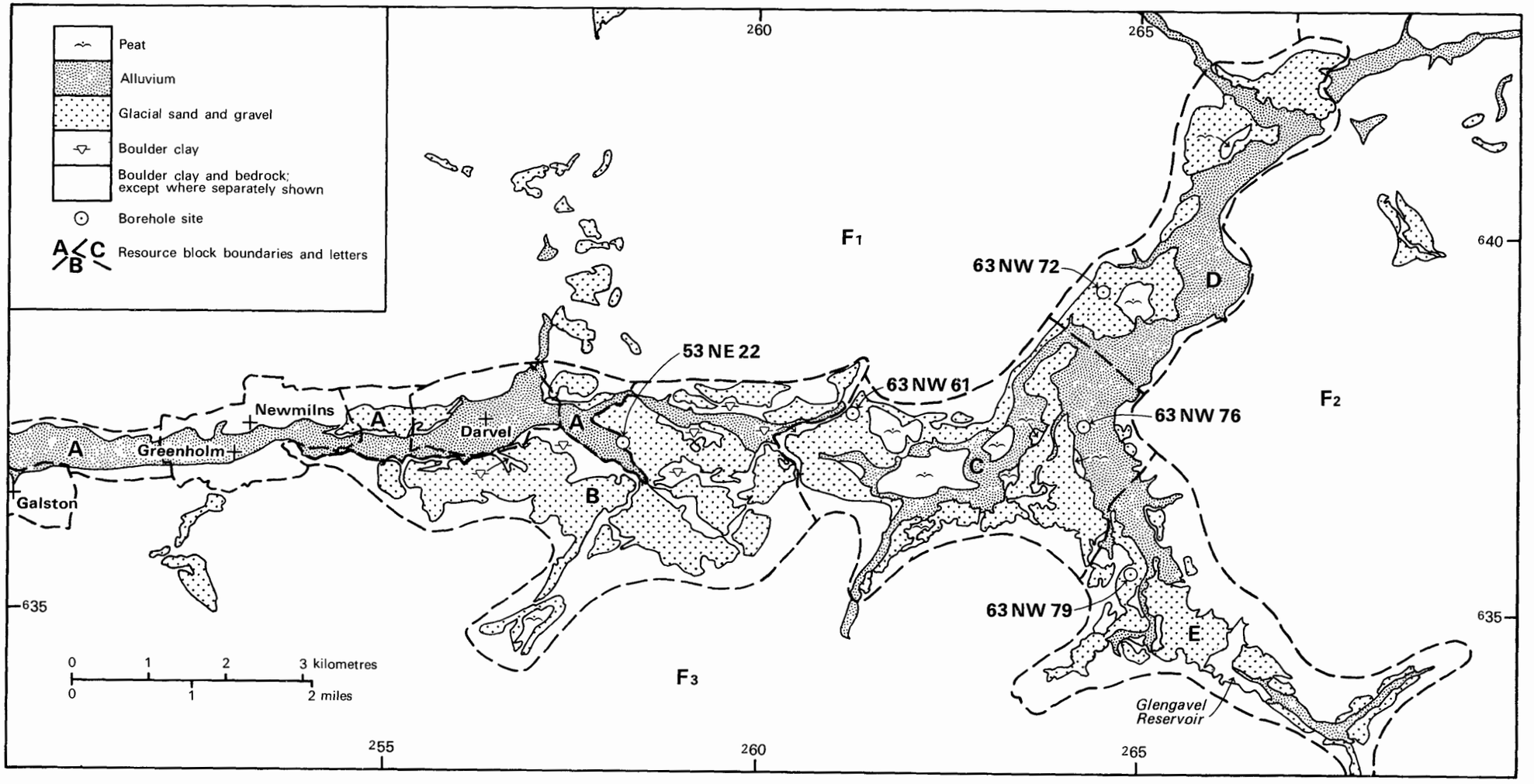


Fig. 3. Sketch-map showing the drift geology of the Darvel area and the location of boreholes from which samples for special testing were taken

terrace deposits is that they were laid down against stagnant ice occupying the axial region of Avondale.

At this time, ice probably continued to occupy the Irvine and lower Avondale, though upper Avondale probably became completely emergent. East of Drumclog a lake persisted in which laminated silts and clays continued to be deposited to form the greatest thickness of lacustrine clays proved in the course of this survey. On the north side of lower Avondale, sand and gravel deposits overlying glacial lacustrine sediment were laid down by pro-grading deltas infilling the lake. Subsequent erosion has greatly dissected the deltaic deposits.

The eastern extent of the lake is uncertain. However, landform suggests that an ice dam may have existed east of Laigh Crewburn [670 420]. Alternatively the lake system of Avondale may have formed an arm of a late glacial ice-dammed lake occupying the valley of the Clyde (Lake Clyde of Charlesworth, 1926).

In the valley of the Irvine sand and gravel, either as kame terraces or as moundy deposits, overlies boulder clay. This sand and gravel with laminated clays, which are sometimes buried beneath boulder clay (including flow or ablation tills) are thought to have formed in temporary lakes, marginal to ice during deglaciation. On the south side of the valley, ridges generally with north-easterly alignment have steep sides suggestive of ice-contact deposition, the most prominent example being Barr Hill [578 366]. Boreholes show glacial sand and gravel near Lanfine [551 365] to have a variable composition. The deposit, which is generally dirty and contains interbedded boulder clays, is thought to be the product of dead-ice deposition, modified by fluvial processes. The marked absence of glacial sand and gravel west of Darvel suggests that deglaciation of the lower valley of the Irvine was rapid. Alternatively the deposits may have been totally removed by post-glacial erosion.

Partial reworking of many of the glacial deposits occurred during and after deglaciation as the modern drainage system developed. With large volumes of meltwater available, gorges were cut through the drift cover, for example, Changue Glen, and very coarse torrent gravels were deposited locally, notably in the valley of the Irvine. Elsewhere, alluvial deposits vary from gravels to fine sands and silts and commonly form terraces. Locally peat covers the alluvium of Avondale, and in places is also well developed on glacial sand and gravel suggesting a period of saturation, probably related to periglacial conditions.

COMPOSITION OF THE SAND AND GRAVEL

Potentially workable sand and gravel is present in the alluvium, glacial sand and gravel and glacial lake deposits. Where possible the deposits have been separated in the assessment (see Table 2).

Alluvium

Separate statistical assessments are offered for alluvial sand and gravel resources in blocks A and C. In blocks B, D and E alluvium is assessed together with glacial deposits as the limited areal extent of mineral-bearing alluvial deposits and sparse borehole data do not allow separate assessment to be made.

Mean grading of potentially workable alluvium in block A is fines 12 per cent, sand 35 per cent and gravel 53 per cent (for definition of terms see Table 13). The gravel comprises fine and coarse, angular to rounded sandstone and basalt with dolerite, quartz and felsite, and contains 8 per cent of cobble debris. The sand which is evenly divided between fine, medium and coarse grade, is composed of comminuted rock and mineral (mostly quartz) grains. Within the block the fines content of boreholes proving mineral ranges from 5 to 19 per cent and consists of silt and clay.

In block C coarse gravel exceeds fine, pebbles vary from angular to well rounded: up to 4 per cent of cobbles are present. Basalt predominates, occurring in about equal quantities with quartzite, quartz and sandstone. Table 18 shows the result of a pebble count of the +16 mm gravel fraction from borehole 63 NW 76, which proved alluvium from 0.5 to 4.0 m. Further details and description of the methods employed are given in Appendix G. Sand varies from fine to coarse grade and is composed mainly of quartz and rock fragments. The fines content of the alluvium ranges from 3 to 13 per cent and comprises silt. The mean grading of potentially workable alluvium in block C is fines 7 per cent, sand 40 per cent and gravel 53 per cent.

Glacial sand and gravel

Only in block C is it possible in the assessment to separate glacial sand and gravel from other potentially workable deposits. In block A glacial lake deposits are included with glacial sand and gravel in the statistical assessment. For block B, alluvium and glacial lake deposits are combined with glacial sand and gravel. For blocks D and E, alluvium is included with glacial sand and gravel.

In block C the mean grading of glacial sand and gravel is fines 6 per cent, sand 66 per cent and gravel 28 per cent. The gravel, in which fine and coarse fractions are equally developed in addition to cobbles, varies from angular to well rounded and is composed principally of basalt, sandstone, quartzite, quartz, dolerite and felsite. Pebble counts have been made on the +16 mm gravel fraction from borehole 63 NW 61 (Table 16). The overall sand grading is fine and medium with coarse, and it comprises quartz and rock fragments. Fines content of the mineral ranges from 1 to 20 per cent and consists of silt and clay.

Based on data from two boreholes and one natural section, potentially workable glacial deposits in block A (including glacial sand and gravel), have a mean grading of fines 14 per cent, sand 73 per cent and gravel 13 per cent. The gravel fraction, in which up to 7 per cent of cobbles occur locally, comprises fine and coarse,

and is composed principally of basalt and sandstone with quartz. Fine sand predominates and comprises quartz with rock fragments. Stringers rich in coaly debris are common. The mean fines content based on three data points ranges from 9 to 23 per cent.

Although potentially workable alluvium and glacial lake deposits have been assessed with glacial sand and gravel in block B, they are only present in borehole 53 NE 27 and thus have minimal influence on the grading characteristics. Mean grading for the combined deposits is fines 13 per cent, sand 60 per cent and gravel 27 per cent. Boreholes show that cobbles occur throughout the mineral thickness. Pebble counts have been made on the coarse gravel fraction from borehole 53 NE 22 (Table 15) and the results are considered typical of most of the gravel samples from block B. Clasts of coal are found infrequently. Fine and coarse gravel, commonly subrounded, occurs in similar abundance in most boreholes. Sand, which is more often fine than coarse, is composed mainly of qyartz and rock fragments and commonly contains detrital coal. Fines comprise silt and clay.

In block D mean grading for the combined alluvium and glacial sand and gravel is fines 10 per cent, sand 74 per cent and gravel 16 per cent. Fine gravel is more common than coarse and cobbles are scarce. The degree of roundness ranges from sub- to well rounded. Field descriptions of bulk samples show pebbles of igneous rock to be less abundant here than to the west in blocks A, B and C. This visual appraisal is supported by the pebble count made on the +16 mm gravel from borehole 63 NW 72 (Table 17). Fine and medium sand are most abundant and comprise quartz and rock fragments, with coal particles recorded in several boreholes. Fines are composed mainly of silt.

In block E alluvium, which is assessed with glacial sand and gravel, is only present in borehole 63 SE 3. Mean grading is fines 11 per cent, sand 64 per cent and gravel 25 per cent. Cobbles are common in the gravel, which has a more varied composition and much less basalt than elsewhere, exemplified in the pebble count of coarse gravel from borehole 63 NW 79 (Table 19). The degree of roundness of the gravel varies widely. Fine and medium sand are more abundant than coarse. Detrital coal is sometimes present. Fines comprise silt and clay.

Glacial lake deposits

Thinly bedded or laminated fine sand, silt and clay classified as glacial lake deposits occur throughout the area, usually concealed by alluvium and glacial sand and gravel or the latter. Although the bulk of glacial lake deposits are regarded as not potentially workable, the uppermost beds usually contain less than 40 per cent fines and are considered to be mineral. Over 80 per cent of the mineral-bearing glacial lake deposits comprise fine sand and fines, typified by the mean grading in the assessment for blocks C, D and E, which shows fines 20 per cent, sand 79 per cent and gravel 1 per cent. The sand is mainly composed of quartz, often with noticeable amounts of detrital coal. Fines comprise silt and clay.

SPECIAL TESTS

Six gravel samples from five boreholes distributed over resource blocks B, C, D and E (Figure 3) were submitted to the Building Research Establishment at East Kilbride, for determination of specific gravity, aggregate impact value and moisture absorption (described in BS 812). Concrete cubes made with the aggregate were tested for drying shrinkage, moisture expansion and water absorption.

When the results (Table 1) are related to sample composition as determined by pebble count (Appendix G), no correlation is readily apparent. However, the following factors and observations should be noted:

(1) Sieve grading shows the samples to be sandy and there to have been insufficient material for 10 per cent fines tests.

(2) The aggregate-impact value (AIV) test was carried out on $\frac{3}{4}$ to 3/8 in material and not the $\frac{1}{2}$ to 3/8 in fraction recommended in BS 812. The results of AIV tests are high and may indicate a large proportion of soft material, for example, weathered basalt and friable sandstone.

(3) Specific gravity for the $\frac{3}{4}$ to 3/8 in fraction ranges from 2.51 to 2.61.

(4) Moisture absorption percentages for the $\frac{3}{4}$ to 3/8 in fraction are comparatively high, indicating that the samples were dirty despite washing prior to testing. (P. Park, personal communication). Pebble counts for samples (a) to (e) show that normally Basalt Group material is dominant (>60 per cent) and Gritstone Group subordinate (<26 per cent). In sample (f) the very high moisture absorption may be attributed to the dominance of Gritstone Group material (64 per cent).

(5) Drying shrinkage values for concrete cubes, which were determined according to BRE Digest 35, range from 0.062 to 0.082 per cent. Concretes in the 0.060 to 0.080 per cent shrinkage range show reduced durability if exposed to weather but may be used for all internal structural purposes except thin reinforced members. Concretes with shrinkage values greater than 0.080 per cent are not usually suitable for most types of structural members (R. Lovegrove, personal communication). The two lowest shrinkage values are for samples (d) and (f), which include a significant proportion of Quartzite Group material.

THE MAP

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

Table 1. Results of special tests

			Tested to BS 812			Tested to BRE Digest 35		
			Gravel Aggregate ($\frac{3}{4}$ to 3/8 in)			Concrete		
Sample	Borehole	Depth (m)	Specific gravity	Aggregate impact value	Moisture absorption %	Drying shrinkage %	Moisture expansion %	Water absorption %
(a)	53NE22	1.7 - 2.6	2.59	26	3.59	0.082	0.070	6.2
(b)	63NW61	3.6 - 4.6	2.61	18	3.66	0.075	0.064	6.2
(c)	63NW72	0.5 - 1.7	2.57	18	3.21	0.070	0.065	6.1
(d)	63NW76	3.2 - 4.0	2.61	22	2.58	0.062	0.060	6.1
(e)	63NW79	3.0 - 4.0	2.56	22	3.19	0.075	0.065	6.3
(f)	63NW79	14.0 - 15.0	2.51	24	4.24	0.065	0.056	6.2
		mean	2.58	22	3.41	0.072	0.063	6.2

Geological data

The geological boundary lines are taken from the geological maps of the area, which were surveyed on the scale of 1:10 560 or 1:10 000. The boundaries are the best interpretation of information available at the time of survey. However it is inevitable, particularly with variable superficial deposits, that locally the accuracy of the map will be improved as new evidence from boreholes and excavations becomes available.

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

Mineral resource information

For assessment purposes the map is divided into areas of mineral and areas where sand and gravel are not assessed, not potentially workable or absent (for definitions of 'mineral' and 'potentially workable' see pp. 1 and 3). The mineral is further subdivided into areas where it crops out (possibly with a covering of soil) and areas where it is present in continuous spreads beneath overburden. However, within these areas there may be small patches where sand and gravel is absent or not potentially workable, as for example, around borehole 53 NE 34. Areas where bedrock crops out, where superficial deposits do not contain mineral, and where sand and gravel is deemed to be not potentially workable are shown uncoloured. Areas of unassessed sand and gravel, for example built-up areas, are indicated by a red stipple.

For the most part the distribution of categories of deposits is based on the mapped geological boundaries. Where there is a transition from one category to another, which cannot be related to the geological maps and which could not be accurately delineated during this survey, inferred boundaries have been inserted. Such boundaries are shown by a distinctive symbol, which is intended to convey an approximate location within a likely zone of occurrence rather than to represent the breadth of the zone; its width is dictated by cartographic considerations. For the purpose of measuring areas the centre-line of the symbol is used.

RESULTS

The results are summarised in Tables 2 and 3. Further particulars are shown in Tables 4 to 12. The mean gradings and the grading 'envelope' for resources in each block are given in Figures 4 to 12.

Accuracy of results

For the resource blocks assessed statistically the accuracy of the results at the symmetrical 95 per cent probability level ranges from 36 to 65 per cent. However, the true values are more likely to be nearer the figure estimated than the limits. Moreover, it is probable that in each block roughly the same percentage limits would apply for the estimate of volume of a very much smaller parcel of ground (say, one hundred hectares) containing similar sand and gravel deposits if results from the same number of sample points (as provided by, say, ten boreholes) were used in the calculation. Thus, if closer limits are needed for the quotation of reserves of part of a block it can be expected that data from more than ten sample points will be required, even if the area is quite small.

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

Table 2. The sand and gravel resources: summary of statistical assessments

	Resource Block	Area		Mean Thickness				Volume		Limits at 95% probability level		Mean grading percentage		
		Block	Mineral	Overburden		Mineral		million	million	±%	±volume	Fines	Sand	Gravel
		km^2	km^2	m	ft	m	ft	m^3	yd^3		million m^3	-1/16mm	-4+1/16mm	+4mm
A	Undifferentiated glacial sand and gravel and glacial lake deposits	3.0	0.5	3.3	10.8	10.1	33.1	5	7	65	3	14	73	13
	Alluvium	3.0	1.7	0.4	1.3	2.6	8.5	4	5	48	2	12	35	53
	Total	3.0	2.2					9	12					
B	Undifferentiated glacial sand and gravel, alluvium and glacial lake deposits	11.9	6.3	1.1	3.6	9.8	32.2	62	81	53	33	13	60	27
C	Glacial sand and gravel	9.8	5.2	1.9	6.2	8.8	28.9	46	60	45	21	6	66	28
	Alluvium	9.8	3.2	0.4	1.3	3.6	11.8	12	16	48	6	7	40	53
	Total including glacial lake deposits	9.8	6.8	1.1	3.6	9.8	32.2	67	88	40	27			
D	Undifferentiated glacial sand and gravel and alluvium	6.9	3.0	0.5	1.6	5.2	17.1	16	21	53	8	10	74	16
	Total including glacial lake deposits	6.9	3.0	0.5	1.6	6.7	22.0	20	26	59	12			
E	Undifferentiated glacial sand and gravel and alluvium	7.9	2.9	1.5	4.9	11.6	38.1	33	43	42	14	12	63	25
	Total including glacial lake deposits	7.9	2.9	1.4	4.6	12.0	39.4	35	46	36	12			
C,D,E	Glacial lake deposits	24.6	3.2	9.1	29.9	4.8	15.7	15	20	48	7	20	79	1
	Built up area	5.1												
	Total	44.6	21.2	1.1	3.6	9.1	29.9	193	253	20	39			

Table 3. The sand and gravel resources: summary of inferred assessments

Resource Block	Area		Mean Thickness				Volume		Limits at 95% probability level		Mean grading percentage		
	Block	Mineral	Overburden		Mineral		million	million	±%	±volume	Fines	Sand	Gravel
	km^2	km^2	m	ft	m	ft	m^3	yd^3		million m^3	-1/16mm	-4+1/16mm	+4mm
F_1	76.4	0.8	0.5	1.6	1.6	5.2	1.0	1.3	speculative		12	39	49
F_2	33.3	0.4	0.5	1.6	2.5	8.2	0.5	0.7	speculative		11	25	64
F_3	45.7	0.4	0.3	1.0	4.7	15.4	1.5	2.0	speculative		16	60	24
Total	155.4	1.6	0.4	1.3	2.8	9.2	3.0	4.0	speculative		14	49	37

NOTES ON THE RESOURCE BLOCKS

In general, the resource block boundaries reflect the distribution of different mineral-bearing deposits within the area (Figure 3). The bulk of the sand and gravel deposits occupy the broad through valley of the Irvine and Avon, which for assessment purposes is divided into five resource blocks. The burghs of Galston, Newmilns and Greenholm, and Darvel have not been assessed. The remaining area of the resource sheet constitutes block F.

Block A

No assessment is offered for the burgh areas of Newmilns and Greenholm, and Darvel, which divide the block into three parts: nor is Galston burgh assessed. Between Newmilns and Priestland [578 375] the southern and eastern block boundary follows the geological boundary of alluvial deposits against glacial drift. Elsewhere the block boundaries have been drawn arbitrarily to include the low-lying ground and flanks of the valley of the Irvine. The Irvine flood plain descends gradually from about 122 m (400 ft) above Ordnance Datum in the east to about 47 m (155 ft) above Ordnance Datum in the west.

To the west of Newmilns and Darvel, boreholes 53 NW 67 and 53 NW 69 prove terraced alluvium on glacial lake silts and clays, which in turn overlie boulder clay. Geological mapping and borehole evidence indicate that boulder clay (rarely with thin bands of sand and gravel, for example in borehole 53 NW 71 lying to the north of the block) forms the valley sides and generally rests on bedrock. However, several small natural sections and boreholes 53 NW 74 and 53 NW 75 located within Newmilns burgh indicate that boulder clay, usually less than 4.0 m thick, overlies glacial lake deposits, illustrating the complex geological history of the area.

Between Newmilns and Darvel, borehole 53 NW 76 proves alluvium on bedrock. Glacial drift comprising sand and gravel with lacustrine deposits and boulder clay, exemplified by boreholes 53 NE 12 and 53 NE 13, forms steep slopes to the north of the valley.

East of Darvel, borehole 53 NE 18 proves alluvium on glacial sand and gravel. To the south-east, borehole 53 NE 23 shows alluvium on boulder clay, which in turn overlies glacial lake deposits. Section 53 NE 32 to the north of Priestland demonstrates glacial sand and gravel overlying glacial lake silt and fine sand.

Separate assessments are offered for potentially workable glacial deposits, that is glacial sand and gravel and glacial lake deposits, and for alluvial deposits, which mainly comprise reworked glacial material.

Potentially workable glacial deposits were proved at four data points, namely, two Industrial Minerals Assessment Unit boreholes, one natural and one temporary section [5724 3784]: all prove glacial sand and gravel and except for the temporary section also demonstrate glacial lake deposits. Because of the paucity of data and the complex interrelationships of the deposits they have been considered together in the calculation of resources.

Glacial lake deposits include 'clayey' to 'very clayey' fine sand, laminated silt and clay. Generally over 80 per cent by weight of the mineral component is less than $\frac{1}{4}$ mm. Borehole 53 NE 12 proves 10.8 m of boulder clay on 5.0 m of glacial sand and gravel overlying 9.2 m of glacial lake deposits of which the upper 8.0 m is mineral. Approximately 300 m to the south, borehole 53 NE 13 demonstrates 2.5 m of glacial sand and gravel within glacial lake deposits. Of the upper 4.9 m of glacial lake deposit, 3.1 m is considered to be potentially workable. The lower 16.0 m of glacial lake deposit consists predominantly of silt, but two beds of potentially workable 'very clayey' fine sand which occur from 9.0 to 10.0 m and from 11.0 to 12.0 m in depth, have not been considered in the calculation of resources as they form a small part of a sequence regarded as generally unworkable. Section 53 NE 32 exhibits 8.0 m of glacial sand and gravel on 6.5 m of potentially workable glacial lake deposit, the base of which was not seen.

Potentially workable deposits beneath overburden were discovered in borehole 53 NE 12. General geological considerations have been used to draw an inferred boundary to the north of the borehole site delineating an area of buried mineral which may be more or less extensive than indicated on the map. Except in this area, where they are obscured by boulder clay overburden, potentially workable glacial deposits are shown on the resource map as exposed mineral; it is considered that the overburden thickness of 2.4 m proved in borehole 53 NE 13 is anomalous. The mean overburden thickness of 3.3 m takes account of the area of concealed mineral. The mean thickness of potentially workable glacial deposits is 10.1 m. The volume of potentially workable glacial deposits is estimated to be 5 million m^3 $\pm$ 65 per cent. Based on two Industrial Minerals Assessment Unit boreholes and one natural section, the mean grading for the glacial deposits is 14 per cent fines, 73 per cent sand and 13 per cent gravel. Fines range from 9 per cent in section 53 NE 32 to 23 per cent in borehole 53 NE 13; sand from 57 per cent in borehole 53 NE 13 to 84 per cent in borehole 53 NE 12; gravel from nil in 53 NE 12 to 24 per cent in section 53 NE 32. Further details are given in Table 4 and Figure 4.

Five Industrial Minerals Assessment Unit boreholes, namely 53 NW 67, 53 NW 69, 53 NW 76, 53 NE 18, 53 NE 23 and one other record, borehole 53 NW 51, prove potentially workable alluvium, mean thickness 2.6 m, beneath a mean thickness of 0.4 m overburden comprising soil. Mineral thickness varies from 1.1 m in borehole 53 NW 69 to 4.1 m in borehole 53 NW 76. Borehole 53 NE 18 proves 4.9 m of alluvial deposits, of which 3.7 m is mineral, overlying 4.1 m of glacial sand and gravel. Because of the lack of information about the areal extent of the latter deposit, it has not been included in the estimation of resources. The estimated volume of potentially workable alluvium is 4 million m^3 $\pm$ 48 per cent. Based on five Industrial Minerals Assessment Unit boreholes,

Table 4. Block A: data from assessment boreholes and exposures - resources in the glacial sand and gravel and glacial lake deposits

Borehole No.	Recorded thickness (m)		Mean grading percentage						
	Overburden	Mineral	Fines -1/16 mm	Fine sand -¼+1/16 mm	Medium sand -1+¼ mm	Coarse sand -4+1 mm	Fine gravel -16+4 mm	Coarse gravel -64+16 mm	Cobble gravel +64 mm
53 NE 12	10.8	13.0	16	72	12	trace	trace	trace	0
53 NE 13	2.4	5.6	23	47	8	2	3	10	7
*53 NE 32	0	13.8	9	38	18	11	13	10	1
Mean	3.3	10.1	14	55	13	5	6	6	1

* natural section

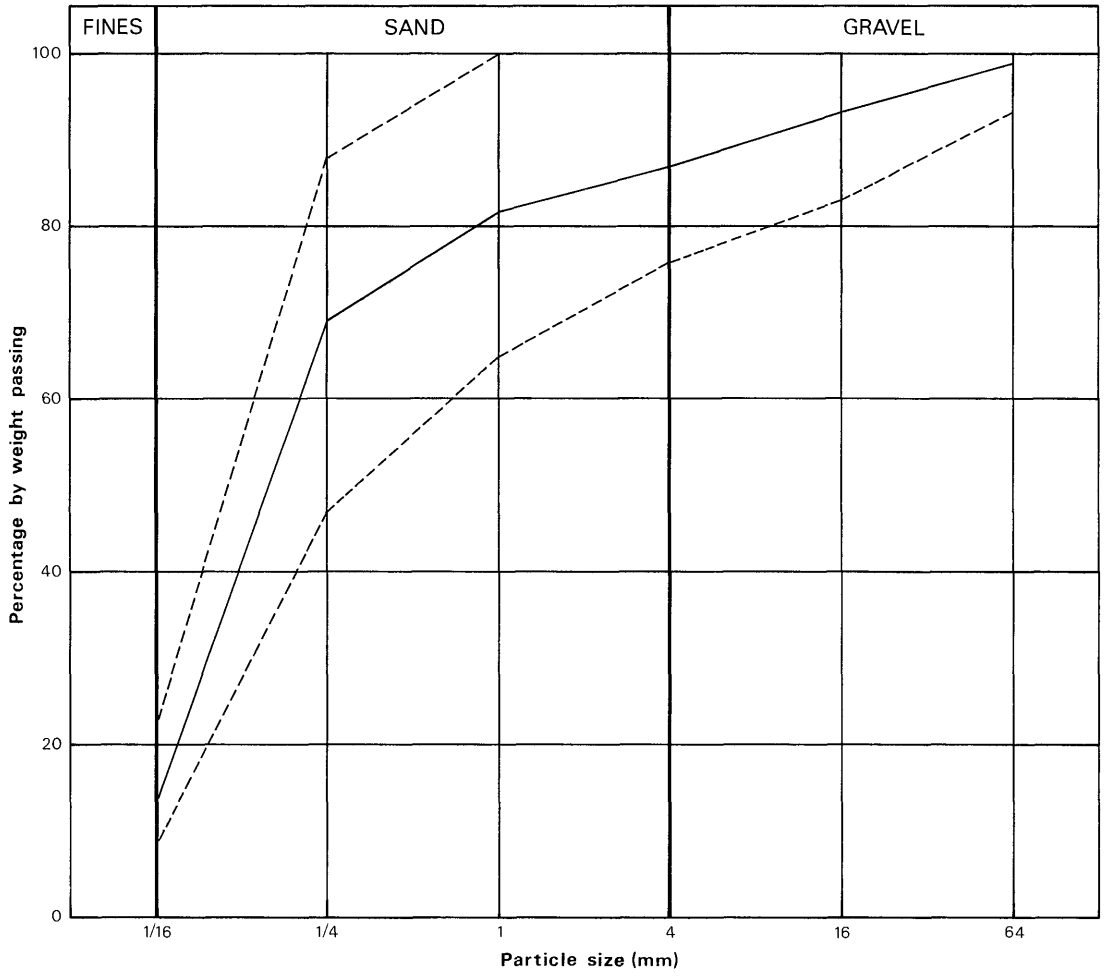


Fig. 4. Grading characteristics of the resources in the glacial sand and gravel and glacial lake deposits in block A: the continuous line represents the weighted mean grading of the resource; the broken lines denote the envelope containing the mean grading curves for individual boreholes proving resources.

Table 5. Block A: data from assessment boreholes - resources in the alluvium

Borehole No.	Recorded thickness (m)		Mean grading percentage						
	Overburden	Mineral	Fines -1/16 mm	Fine sand $-\frac{1}{4}+1/16$ mm	Medium sand $-1+\frac{1}{4}$ mm	Coarse sand -4+1 mm	Fine gravel -16+4 mm	Coarse gravel -64+16 mm	Cobble gravel +64 mm
53 NW 67	0.3	2.8	14	14	12	13	21	19	7
53 NW 69	0.4	1.1	6	5	10	12	20	27	20
53 NW 76	0.6	4.1	5	5	9	16	27	28	10
53 NE 18	0.3	3.7	19	20	11	9	14	20	7
53 NE 23	0.3	1.9	15	9	17	17	20	16	6
Mean	0.4	2.6	12	11	11	13	24	21	8

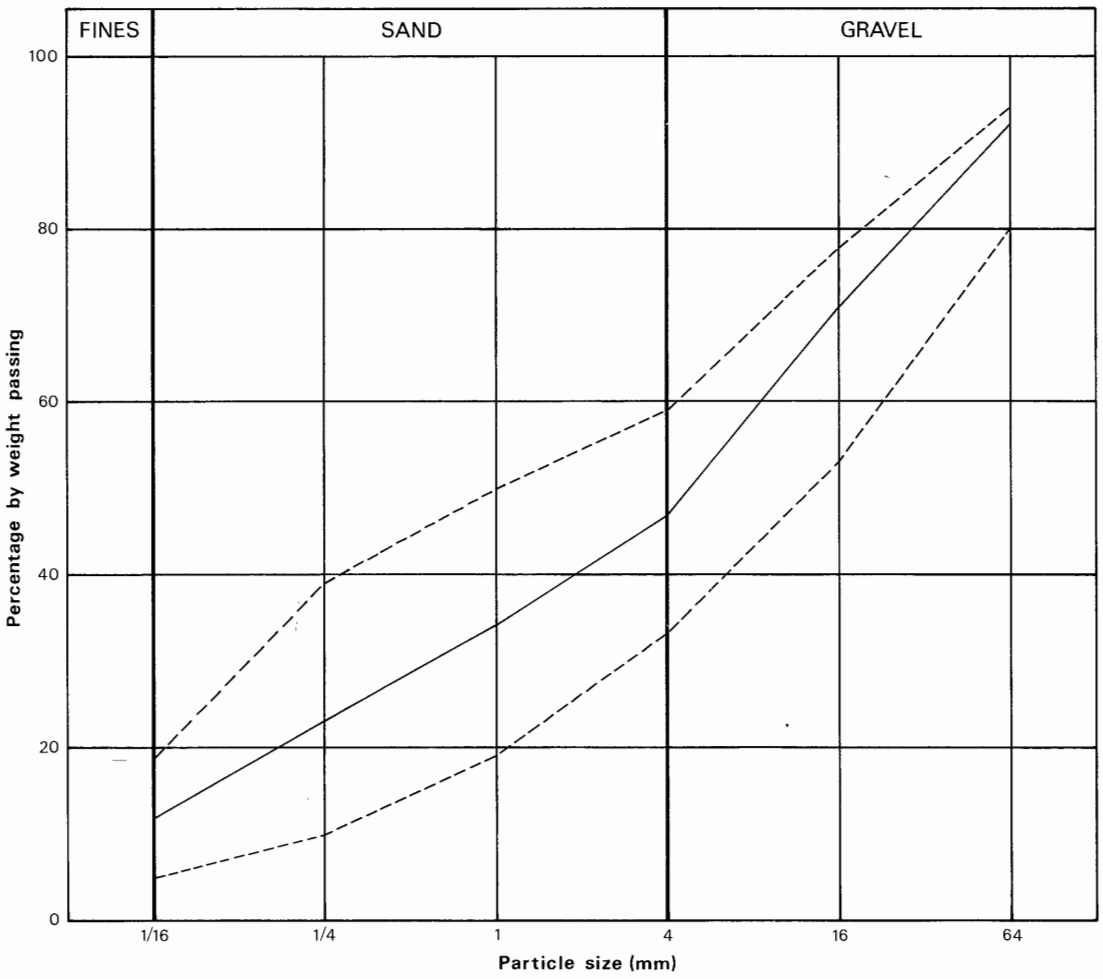


Fig. 5. Grading characteristics of the resources in the alluvium in block A. (For explanation see Fig. 4.)

the mean grading for alluvium is 12 per cent fines, 35 per cent sand and 53 per cent gravel. Fines range from 5 per cent in borehole 53 NW 76 to 19 per cent in borehole 53 NE 18; sand from 27 per cent in borehole 53 NW 69 to 43 per cent in borehole 53 NE 23; gravel from 41 per cent in borehole 53 NE 18 to 67 per cent in borehole 53 NW 69. For additional details see Table 5 and Figure 5.

The statistical methods employed for the calculation of resources assume random distribution of data points. As the data from the potentially workable alluvial and glacial deposits form two distinct populations, it is not possible to offer a statistical assessment for the deposits as a whole.

Block B

The northern and southern block boundaries have been drawn arbitrarily to include extensive spreads of glacial sand and gravel abutting the Irvine, the Changue Burn and Tulloch Burn. Block A lies to the west and north. The eastern block boundary follows the deeply incised valley created by the headwaters of the Irvine as far west as the old railway viaduct [602 374], where it swings south-eastwards towards Cairnsaigh Hill. The deeply incised valleys of the Changue Burn and Tulloch Burn, which expose bedrock over much of their course, separate the glacial deposits into three areas.

To the west of Changue Burn, boreholes show that glacial sand and gravel averages 4 m in thickness. The relationship of glacial sand and gravel to boulder clay is complex, boreholes showing the former to locally overlie, underlie or be enveloped by the latter. Boreholes 53 NE 14 and 53 NE 15 show 4.5 m and 1.9 m of mineral respectively, overlying boulder clay. The latter borehole also proves a lower 7.9 m of glacial sand and gravel with thin seams of clay overlying boulder clay. Borehole 53 NE 19 proves 1.8 m of glacial sand and gravel within boulder clay, but the latter is absent in borehole 53 NE 20, where glacial sand and gravel rests directly on bedrock. Glacial sand and gravel has been worked at Barr Hill.

Eastwards, in the area contained by the Changue Burn and Tulloch Burn, boreholes show that glacial sand and gravel averages 17 m in thickness. Glacial sand and gravel proved in boreholes 53 NE 24 and 53 NE 31 overlies boulder clay but in borehole 53 NE 25, which was taken to 24.5 m, the base of the sand and gravel deposit was not proved beyond doubt.

The area between the Irvine and the Tulloch Burn contains extensive deposits of glacial sand and gravel, forming ill-defined terraces, the upper surface level of which descends from about 226 m (740 ft) above Ordnance Datum in the south-east to about 130 m (425 ft) above Ordnance Datum in the west. Boreholes 53 NE 28 and 63 NW 58 show respectively 1.1 and 4.9 m of mineral overlying boulder clay. In borehole 53 NE 29, 8.6 m of boulder clay divides an upper deposit of glacial sand and gravel 10.3 m thick from a lower, at least 5.8 m in thickness, the base not being reached when the borehole was terminated at 25 m depth. Borehole 53 NE 22, abandoned at a depth of 9.0 m, does not prove the base of the glacial sand and gravel. Boreholes 53 NE 30 and 63 NW 59, sited on boulder clay, prove waste on bedrock and have been considered in determining the extent of barren ground.

Alluvium of the Irvine is shown by borehole 53 NE 27 to overlie glacial lake deposit and glacial sand and gravel, the base of which was not reached when the borehole was terminated at 25 m. The alluvial and glacial deposits thin rapidly eastwards and in the valley of the upper Irvine are thought to be less than 1 m thick. A zig-zag line [604 375] limits the extent of potentially workable alluvium. North of the Irvine isolated patches of glacial sand and gravel overlie boulder clay, for example in borehole 53 NE 26. To the east, in borehole 63 NW 57, glacial lake silts are intercalated with boulder clay.

Alluvium and potentially workable glacial deposits have been considered as a whole in the assessment. In boreholes 53 NE 15 and 53 NE 29, where thick waste bands separate upper and lower deposits of sand and gravel, only the upper deposits have been considered in the calculation of resources. It is thought that office record, borehole 53 NE 34, which proves 4.0 m waste in an area mapped as sand and gravel, is anomalous but it is not possible on the basis of one data point to outline an area of barren ground. The record has, however, been considered in the resource estimation and affects the mean thickness of overburden, which is calculated to be 1.1 m. In areas containing mineral at or near the surface overburden averages 0.6 m.

The assessment of resources is based on seventeen Industrial Minerals Assessment Unit boreholes, one office record and commercial data. Mineral ranges in thickness from 1.1 m in borehole 53 NE 28 to in excess of 24.5 m in borehole 53 NE 27. Generally, the thicker deposits are found in the valley of the Irvine and in the area contained by the Changue Burn and Tulloch Burn. The mean thickness of mineral is 9.8 m. The volume of mineral is estimated at 62 million m^3 $\pm$ 53 per cent.

The mean grading of the mineral based on thirteen Industrial Minerals Assessment boreholes is 13 per cent fines, 60 per cent sand and 27 per cent gravel. In borehole 63 NW 58, 4.9 m of mineral includes 0.7 m of boulder clay which, grading as 'very clayey' sand, has been considered in the calculation of mean grading. A lower 1.0 m of boulder clay, grading as 'clayey' gravel, has not been included, as it forms only a small part of a sequence regarded as unworkable. The fines content of the mineral, which ranges from 8 per cent in borehole 53 NE 29 to 32 per cent in borehole 53 NE 28, is less than 10 per cent in two boreholes and greater than 20 per cent in two boreholes. The proportion of sand varies from 27 per cent in borehole 53 NE 19 to 75 per cent in boreholes 53 NE 27 and 53 NE 29, but is less than 45 per cent in only two boreholes. The proportion of gravel varies from 2 per cent in borehole 53 NE 28 to 58 per cent in borehole 53 NE 19 but usually lies in the range 15 to 45 per cent. Additional data appear in Table 6 and Figure 6.

Table 6. Block B: data from assessment boreholes - resources in the glacial sand and gravel, alluvium and glacial lake deposits

Borehole No.	Recorded thickness (m)		Mean grading percentage						
	Overburden	Mineral	Fines -1/16 mm	Fine sand -$\frac{1}{4}$+1/16 mm	Medium sand -1+$\frac{1}{4}$ mm	Coarse sand -4+1 mm	Fine gravel -16+4 mm	Coarse gravel -64+16 mm	Cobble gravel +64 mm
53 NE 14	0.3	4.5	16	27	19	12	14	11	1
53 NE 15	0.7	1.9	21	30	12	6	8	16	7
53 NE 19	1.2	1.8	15	11	8	8	13	36	9
53 NE 20	0.4	6.8	13	9	10	14	25	22	7
53 NE 22	0.5	8.5	13	22	12	11	19	19	4
53 NE 24	0.7	16.0	9	31	25	10	11	9	5
53 NE 25	0.3	24.0	18	17	17	13	17	17	1
53 NE 26	0.6	24.2	15	34	24	10	10	6	1
53 NE 27	0.5	24.5	13	46	24	5	5	6	1
53 NE 28	0.5	1.1	32	47	16	3	2	0	0
53 NE 29	0.3	10.3	8	23	44	8	8	9	0
53 NE 31	1.3	12.9	12	17	19	13	18	21	trace
63 NW 58	0.7	4.9	13	28	21	9	13	13	3
Mean	1.1	9.8	13	28	22	10	13	12	2

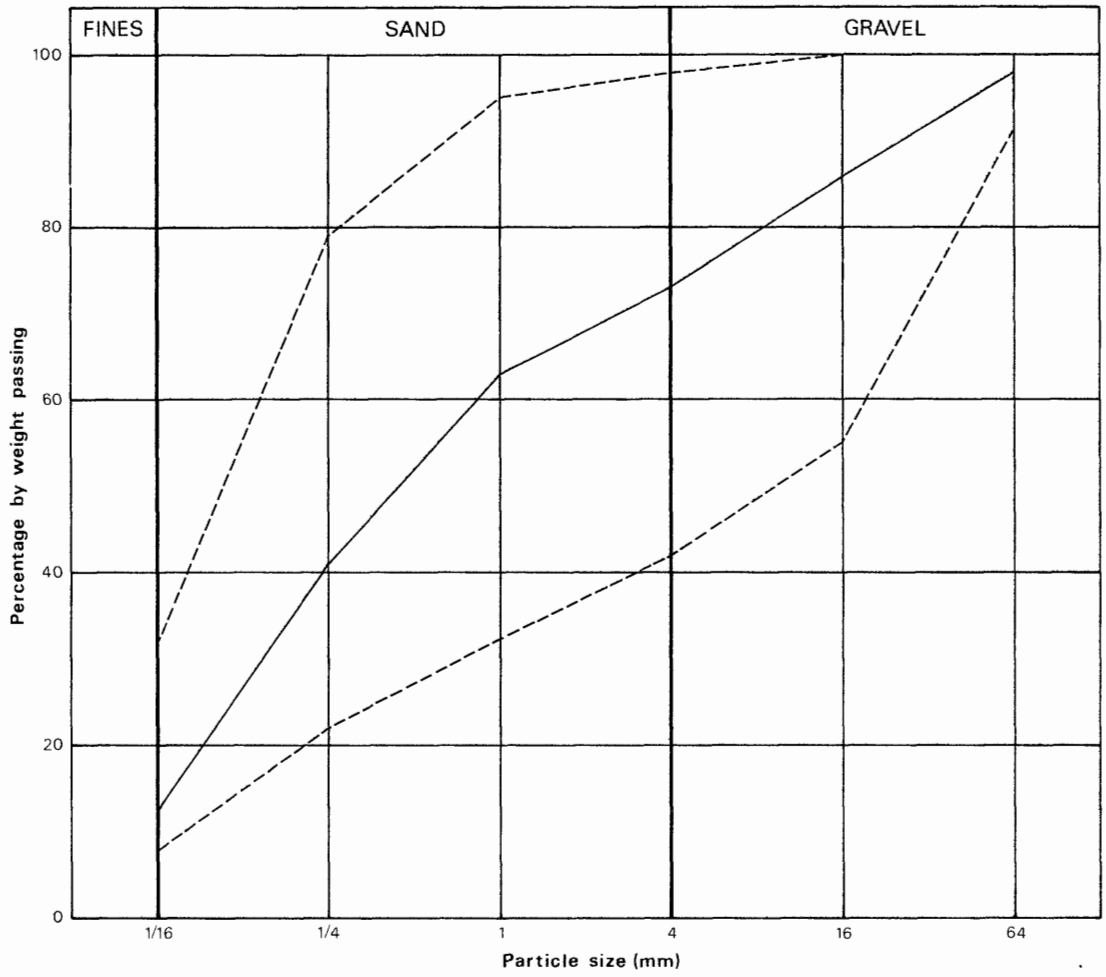


Fig. 6. Grading characteristics of the resources in the glacial sand and gravel, alluvium and glacial lake deposits in block B. (For explanation see Fig. 4.)

Table 7. Block C: data from assessment boreholes and exposures - resources in the glacial sand and gravel

Borehole No.	Recorded thickness (m)		Mean grading percentage						
	Overburden	Mineral	Fines -1/16 mm	Fine sand $-\frac{1}{4}+1/16$ mm	Medium sand $-1+\frac{1}{4}$ mm	Coarse sand -4+1 mm	Fine gravel -16+4 mm	Coarse gravel -64+16 mm	Cobble gravel +64 mm
63 NW 61	0.6	16.1	6	33	28	8	11	11	3
63 NW 62	4.6	3.0	14	33	14	7	9	23	0
63 NW 63	1.0	1.6	6	12	15	17	29	21	0
63 NW 64	1.1	2.1	10	9	16	17	27	21	0
63 NW 65	2.0	4.6	4	7	10	16	28	35	0
63 NW 66	0.5	3.9	20	27	18	15	9	11	0
63 NW 68	8.5+	11.0	8	40	29	4	5	7	7
63 NW 69	0.3	2.2	11	32	18	8	9	22	0
63 NW 70	2.5	12.9	6	15	25	18	18	14	4
63 NW 75	0.3	2.4	5	52	40	1	1	1	0
63 NW 77	3.6+	16.0	3	21	34	14	17	11	0
63 NW 78	0.5	13.5	3	15	26	9	13	18	16
*63 NW 80	0	18.7	4	34	30	7	9	14	2
*63 NW 81	0	10.7	1	18	56	11	9	5	0
Mean	1.9	8.8	6	28	28	10	12	12	4

* pit section
\+ includes potentially workable alluvium

Table 8. Block C: data from assessment boreholes - resources in the alluvium

Borehole No.	Recorded thickness (m)		Mean grading percentage						
	Overburden	Mineral	Fines -1/16 mm	Fine sand $-\frac{1}{4}+1/16$ mm	Medium sand $-1+\frac{1}{4}$ mm	Coarse sand -4+1 mm	Fine gravel -16+4 mm	Coarse gravel -64+16 mm	Cobble gravel +64 mm
63 NW 68	0.5	2.7	5	5	10	14	20	32	14
63 NW 74	0.2	5.0	7	17	17	14	22	23	0
63 NW 76	0.5	3.5	3	12	14	10	21	36	4
63 NW 77	0.6	3.0	13	10	19	14	21	23	0
Mean	0.4	3.6	7	12	15	13	21	28	4

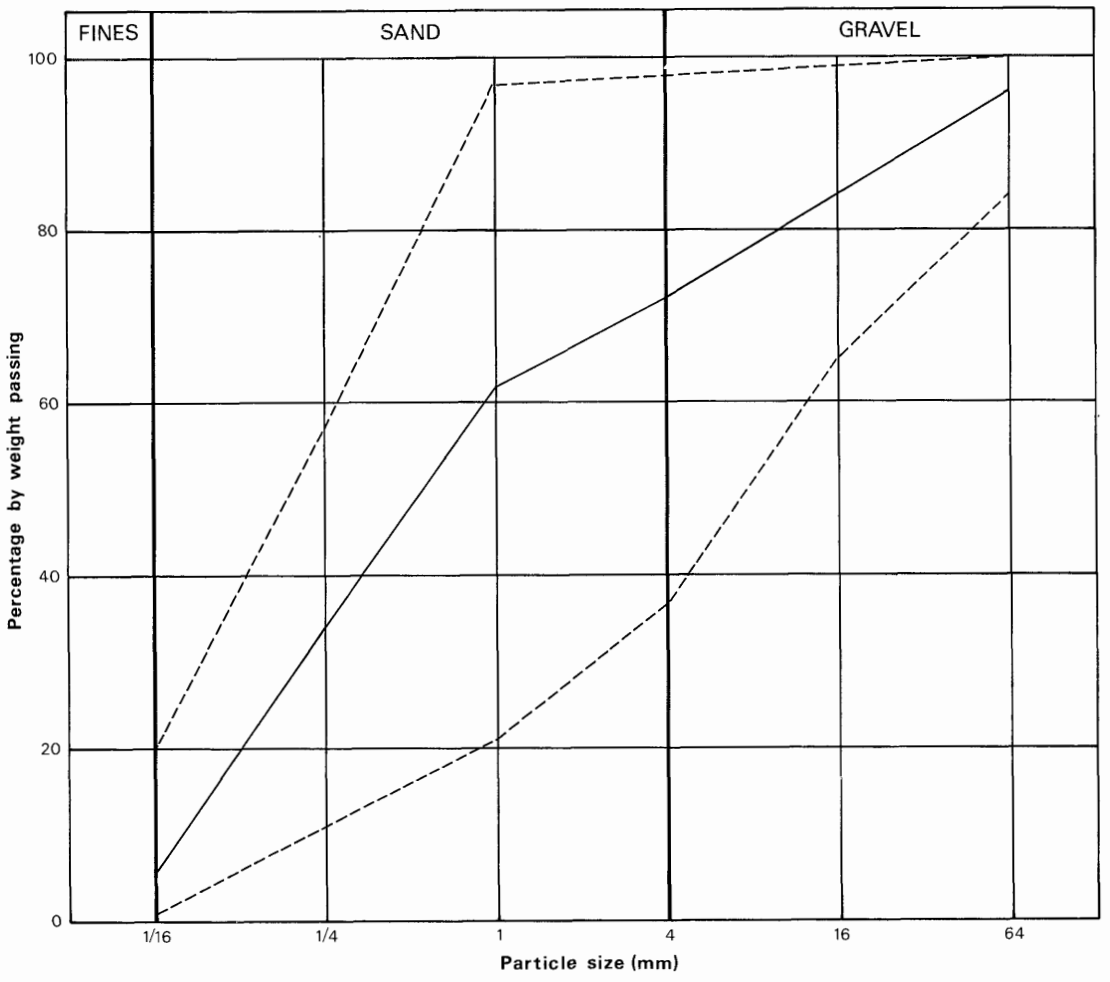


Fig. 7. Grading characteristics of the resources in the glacial sand and gravel in block C (for explanation see Fig. 4.)

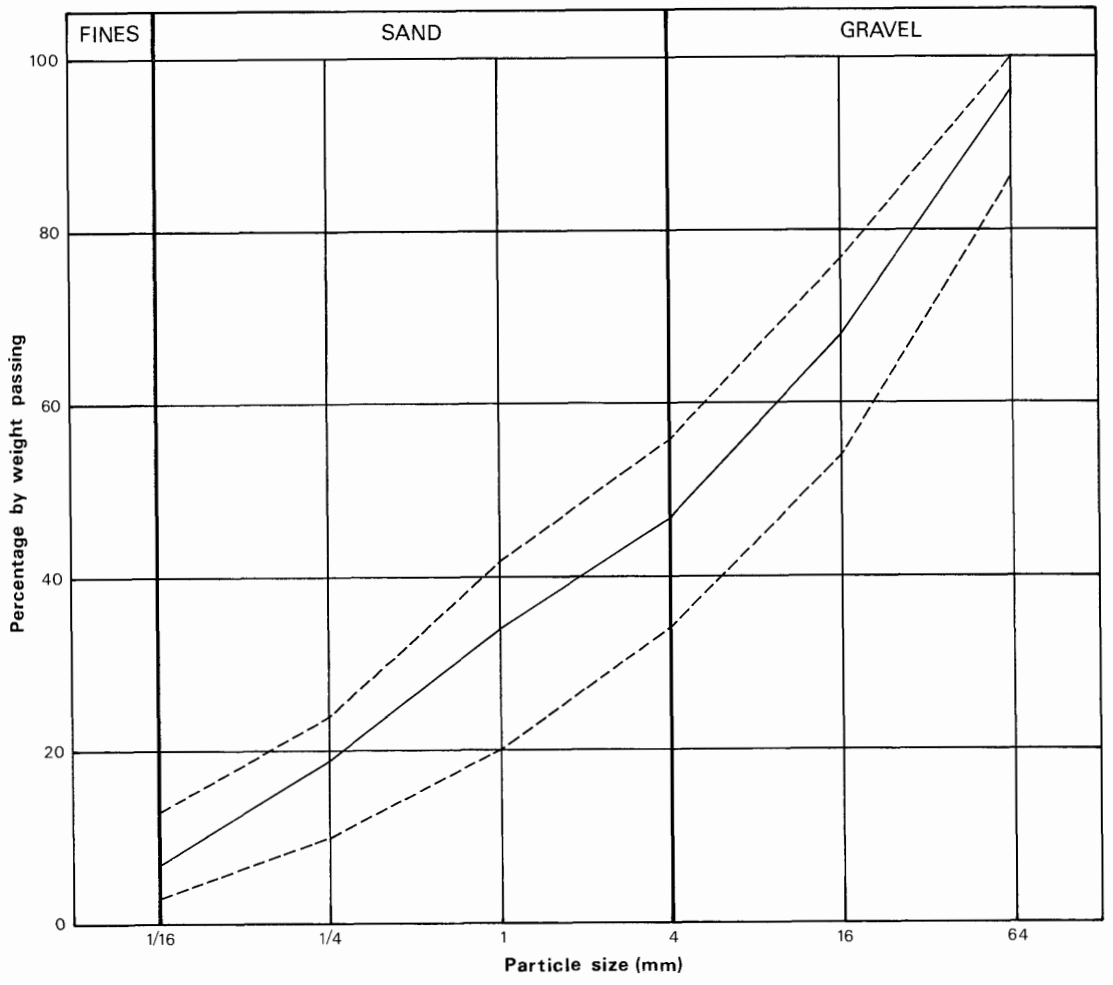


Fig. 8. Grading characteristics of the resources in the alluvium in block C (for explanation see Fig. 4.)

Block C

The northern and southern block boundaries follow the contours of Avondale. Arbitrary boundaries have been drawn to the north-east and south-east, separating the block from the valley of the lower Avon (block D), and upper Glengavel (block E).

The Avon Water rises south of the area in Avon Moss, flows north-eastwards through Avondale from Waterhead Farm [617 357] to North Torfoot [641 385] and has a poorly drained floodplain, locally with large peat bogs. Terraced alluvium overlain by isolated patches of peat, possibly remnants of a more continuous cover, parallel the course of the river. Borehole 63 NW 68 shows that alluvium overlies glacial lake deposits, boulder clay and glacial sand and gravel. Alluvial cones, for example, at Waterhead and Shieloans [629 363] are developed where small streams debouch on to the floodplain.

A series of terraces composed of glacial sand and gravel descend in height from about 220 m (720 ft) above Ordnance Datum near Loudoun Hill to about 190 m (625 ft) above Ordnance Datum at North Torfoot. South of Loudoun Hill, these terraces form a divide separating the westerly draining Irvine from the easterly flowing Avon. Boreholes 63 NW 61 and 63 NW 63 and the section 63 NW 80C prove glacial sand and gravel to overlie glacial lake deposit, the boreholes ultimately penetrating boulder clay. Borehole 63 NW 64 shows 2.1 m of glacial sand and gravel interbedded with boulder clay and in borehole 63 NW 66 glacial sand and gravel overlies boulder clay. Borehole 63 NW 62 proves peat overlying boulder clay, glacial sand and gravel and glacial lake deposits. Moundy topography is displayed by glacial sand and gravel deposits between Shieloans and Stoneyhill [644 364]. Borehole 63 NW 70 proves peat overlying alluvium on glacial sand and gravel, the full thickness of the lower deposit not being proved. Borehole 63 NW 78 proves glacial sand and gravel on glacial lake deposits and boulder clay. To the north of Peelhill [644 367] extensive terraces of glacial sand and gravel are developed and separate the Avon Water from a northerly flowing tributary, the Glengavel Water. Borehole 63 NW 69 proves 2.2 m of glacial sand and gravel overlying boulder clay, but section 63 NW 81, exposing 10.1 m of glacial sand and gravel, does not reveal the full thickness of the deposit.

The Glengavel Water flows through a wide terraced alluvial plain, with small isolated patches of peat. Boreholes 63 NW 74 and 63 NW 76 prove alluvium overlying glacial lake deposits and borehole 63 NW 77 shows alluvium overlying glacial sand and gravel on glacial lake deposit. Along the eastern margin of the block remnant terraces of glacial sand and gravel overlie boulder clay as shown by 63 NW 75. A small alluvial cone is developed adjacent to one such terrace at North Halls Farm [650 372].

Glacial sand and gravel is worked at South Torfoot [637 380] and near Loudoun Hill north of the A71 at [613 374]. It was formerly dug in the latter vicinity south of the road and from two areas west and east of Lochgate [626 374].

Separate assessments are offered for the alluvium and glacial sand and gravel resources: glacial lake deposits, which are considered with similar deposits in blocks D and E, are described in a section following block F. Boreholes 63 NW 67 and 63 NW 71 prove 2.8 m and 2.1 m respectively of waste on bedrock, showing rapid thinning of drift deposits on both the north and south sides of the valley of the Avon. The data have not been used in the calculation but provide the basis for defining areas of barren ground. Inferred boundaries at Avon Bridge [618 362], near Waterhead [621 360], and at Overhouses [636 363] separate continuous spreads of mineral, either beneath overburden or at the surface from barren ground.

Twelve Industrial Minerals Assessment Unit boreholes, data from two pit sections, and commercial information form the basis for the assessment of glacial sand and gravel resources. The mean overburden thickness, 1.9 m, takes account of areas with concealed mineral. In boreholes 63 NW 68 and 63 NW 77 'overburden' to the glacial sand and gravel, includes potentially workable alluvium, which is assessed separately. In boreholes proving potentially workable glacial sand and gravel at or near the surface the average thickness of overburden is 0.4 m. The mean thickness of mineral is 8.8 m. The estimated volume of potentially workable glacial sand and gravel is 46 million m^3 ± 45 per cent. The mean grading for the mineral is 6 per cent fines, 66 per cent sand and 28 per cent gravel. The fines content ranges from 1 per cent in section 63 NW 81 to 20 per cent in borehole 63 NW 66 but commonly lies in the range 3 to 14 per cent; the sand content ranges from 33 per cent in borehole 63 NW 65 to 93 per cent in 63 NW 75 but commonly lies in the range 50 to 75 per cent; the gravel content ranges from 2 per cent in borehole 63 NW 75 to 63 per cent in borehole 63 NW 65. Further details are given in Table 7 and Figure 7.

Four Industrial Minerals Assessment Unit boreholes have been used to assess potentially workable alluvium resources. The mean thickness of overburden is 0.4 m and the mean thickness of mineral, 3.6 m. The estimated volume of potentially workable alluvium is 12 million m^3 ± 48 per cent. The mean grading is 7 per cent fines, 40 per cent sand and 53 per cent gravel. Additional information appears in Table 8 and Figure 8.

An assessment of all potentially workable deposits, including glacial lake sediment, appears on Table 2. The mean overburden thickness is 1.1 m, mean mineral thickness 9.8 m and the estimated volume 67 million m^3 ± 40 per cent.

Block D

The resource block includes the valley of the Avon to the north-east of Drumclog and contains potentially workable deposits of alluvium, glacial sand and gravel and glacial lake deposit. The Avon, joined by the Glengavel Water north-west

Table 9. Block D: data from assessment boreholes - resources in the glacial sand and gravel and alluvium

Borehole No.	Recorded thickness (m)		Mean grading percentage						
	Overburden	Mineral	Fines -1/16 mm	Fine sand -¼+1/16 mm	Medium sand -1+¼ mm	Coarse sand -4+1 mm	Fine gravel -16+4 mm	Coarse gravel -64+16 mm	Cobble gravel +64 mm
63 NW 72	0.5	5.6	6	27	47	8	9	3	0
63 NW 73	0	9.5	6	46	28	6	6	8	0
63 NE 1	0.5	2.8	8	24	19	11	10	26	2
63 NE 3	0.6	2.4	11	23	27	13	17	9	0
63 NE 8	0.5	2.5	14	20	25	13	17	11	0
64 SE 6	0.5	10.5	14	45	24	9	7	1	0
64 SE 7	0.9	1.0	4	7	42	24	18	5	0
64 SE 9	0.5	8.0	11	34	27	10	12	6	0
Mean	0.5	5.2	10	36	29	9	9	7	0

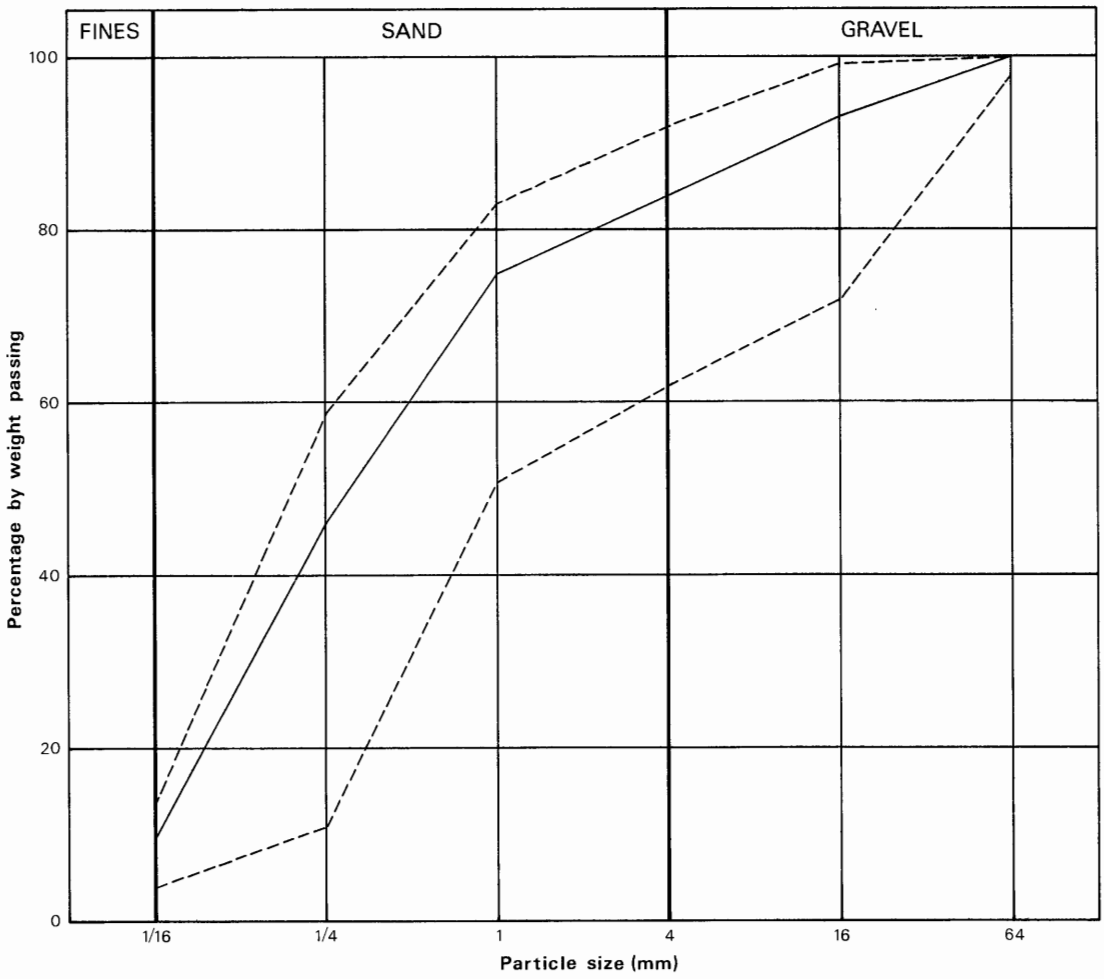


Fig. 9. Grading characteristics of the resources in the glacial sand and gravel and alluvium in block D. (For explanation see Fig. 4.)

of Middle Croft [653 383] meanders north-eastwards through a floodplain with dissected alluvial terraces. At the north-eastern block boundary the river has incised a steep-sided valley into bedrock. Along the sides of the valley of the Avon boulder clay overlies bedrock, as shown by boreholes 63 NE 2 and 64 SW 1.

Alluvium is proved by several boreholes to overlie glacial deposits. Borehole 63 NE 3 proves 2.4 m of alluvium on glacial lake deposit and boulder clay. North-east of Holmhead [655 391] boreholes 63 NE 8 and 64 SE 7 sited on alluvial terraces approximately 4 m above river level prove complex sequences. At the former site, 2.0 m of alluvium (of which 1.0 m is mineral) overlie 1.5 m of glacial sand and gravel, which in turn rests on 20.0 m+ of waste (glacial lake deposit on boulder clay): the latter borehole proves 1.0 m of alluvium overlying 18.7 m+ of waste (glacial lake deposit on boulder clay). Boreholes 64 SE 5 and 64 SE 8 sited on an alluvial terrace some 2 m above river level prove 10.7 m+ and 20.0 m+ of waste respectively. Both boreholes which revealed thin beds of glacial sand and gravel underlying boulder clay discovered artesian water.

Spreads of terraced glacial sand and gravel occur exclusively to the north-west of the Avon and are covered by isolated patches of peat. In the vicinity of Snabe Pit [645 390] the highest surface level at which sand and gravel occurs is about 190 m (625 ft) above Ordnance Datum. To the north-east at Laigh Crewburn glacial outwash occurs up to about 206 m (675 ft) above Ordnance Datum. Borehole 63 NE 1, sited near the margin of the terraced deposits, proves 2.8 m of glacial sand and gravel overlying 14.0 m of glacial lake deposit (of which the upper 2.7 m is mineral) on boulder clay. Borehole 63 NW 72 proves 5.6 m of glacial sand and gravel on 14.9 m of glacial lake deposit (of which the upper 10.9 m is mineral), the latter resting on boulder clay. Borehole 63 NW 73 and section 63 NW 82 in Snabe Pit prove 9.5 m+ and 8.3 m+ of glacial sand and gravel respectively. Near Caldermill [663 418] borehole 64 SE 6 proves 10.5 m of glacial sand and gravel on 11.5 m+ of waste (glacial lake deposit on boulder clay). Borehole 64 SE 9 proves 8.6 m of glacial lake deposit (waste) separating an upper 8.0 m from a lower 3.8 m of glacial sand and gravel. The lower deposit overlies boulder clay.

Glacial sand and gravel is worked at Snabe Pit.

The assessment of resources has been calculated for alluvium and glacial sand and gravel as a whole. Glacial lake deposits have been considered with similar sediments in blocks C and E.

In borehole 64 SE 9 only the upper glacial sand and gravel deposit has been considered in the estimation of resources. Borehole 63 NW 72, rather than section 63 NW 82 in Snabe Pit sited about 25 m to the south-east, has been used in calculation as it is the more complete record. Boreholes 64 SE 5 and 64 SE 8, which proved 10.7 m+ and 20.0 m+ waste respectively, have assisted in defining the inferred boundary near Holmhead separating an area of mineral at or near the surface from an area of waste. Sited on alluvium, borehole 64 SE 8 proved boulder clay at surface and the record is thought to be anomalous.

Based on eight Industrial Minerals Assessment Unit boreholes, the mean grading of mineral is 10 per cent fines, 74 per cent sand and 16 per cent gravel. The proportion of fines ranges from 4 per cent in borehole 64 SE 7 to 14 per cent in borehole 64 SE 6. Sand grade ranges from 54 per cent in borehole 63 NE 1 to 82 per cent in borehole 63 NW 72. Gravel ranges from 8 per cent in borehole 64 SE 6 to 38 per cent in borehole 63 NE 1. Additional data appear in Table 9 and Figure 9. The mean overburden thickness is 0.5 m. Assessed mineral ranges from 1.0 m in borehole 64 SE 7 to 10.5 m in borehole 64 SE 6 and has a mean thickness of 5.2 m. The volume of potentially workable alluvium and glacial sand and gravel is estimated at 16 million $m^3 \pm 53$ per cent.

A statistical assessment of all potentially workable material in the block, including glacial lake deposits, is included on Table 2. Overburden has a mean thickness of 0.5 m and mineral a mean thickness of 6.7 m. The estimated volume is 20 million $m^3 \pm 59$ per cent.

Block E

The block includes the upper reaches of the north-westerly flowing Glengavel Water, its tributaries and Glengavel Reservoir. Terraces of glacial sand and gravel predominate to the west of Glengavel Water and range in surface level from about 270 m (885 ft) above Ordnance Datum at Laigh Plewland [654 352] to about 215 m (705 ft) above Ordnance Datum near Bankend [648 360] (Plate 2). Patches of peat, boulder clay and glacial sand and gravel, with ribbons of alluvium and bedrock, form a mosaic of deposits throughout the block.

Boreholes show the glacial deposits to infill a trough cut in bedrock. Situated in the axial region of Glengavel, boreholes 63 NE 7 and 63 SE 1 prove 15.5 m+ and 20.1 m respectively of glacial sand and gravel. Section 63 NE 14, lying approximately 250 m east-south-east of the former borehole, demonstrates glacial lake silt intercalated with glacial sand and gravel resting on boulder clay. East of the Glengavel Water, three boreholes and a natural section reveal a complex geological history. Borehole 63 NE 6 found 12.1 m of glacial sand and gravel beneath 8.0 m of peat and boulder clay. Borehole 63 NE 5 proves 5.6 m of glacial sand and gravel separating an upper 3.3 m from a lower 13.0 m of glacial lake deposits (10.8 m of the lower deposit is considered potentially workable). Approximately 160 m north-west of this borehole, section 63 NE 12 reveals 8.7 m of glacial lake deposit (the upper 5.7 m is mineral) overlying boulder clay. In the block only boreholes 63 NE 5 and 63 NE 6 prove potentially workable glacial sand and gravel beneath cover. An inferred boundary outlining an area of buried mineral, which may be more or less extensive than indicated, is shown on the map. Although these boreholes show interdigitation of potentially workable material with waste, it is thought that such occurrences

are localised and that generally on the higher eastern slopes of Glengavel boulder clay or peat directly overlies bedrock, as for example in borehole 63 NE 4.

On the western side of the valley, borehole 63 NW 79 proves 20.9 m of glacial sand and gravel with silt partings on boulder clay. Section 63 NE 13 situated approximately 300 m to the north-east displays 15.5 m of glacial sand and gravel, the base of which was not seen. In the valley of the Small Burn, borehole 63 SW 1 sited on an esker ridge penetrated 24.5 m of glacial sand and gravel; the deposit thins towards the south-west, borehole 63 SW 2 proving 4.4 m of glacial sand and gravel on boulder clay.

To the east and south-east of Glengavel Reservoir sand and gravel occurs as isolated patches. Borehole 63 SE 2 proves 6.2 m of glacial sand and gravel on boulder clay.

Alluvium occurs in the valley of the Powbrone Burn where borehole 63 SE 3 shows it to overlie glacial sand and gravel. An inferred boundary [679 337] separates an area of mineral at or near the surface from barren ground. Similarly, an inferred boundary is drawn [671 340] where an alluvial cone is displayed. In Glengavel north of Laigh Plewland alluvium forms a terraced plain. Two inferred boundaries, [651 355 and 656 355], separate areas of mineral at or near the surface from barren ground. Alluvial cones are developed south of Templeland [654 360] and near South Halls [650 369]. Over much of their courses, streams reveal bedrock, for example in Hall's Burn, Woollen Burn, Glengavel Water east of Laigh Plewland and at various localities around and to the south of Glengavel Reservoir.

Glacial sand and gravel and alluvium have been considered as a whole in the calculation of resources. (A description of glacial lake deposits, which are assessed with similar deposits in blocks C and D, follows block F). In borehole 63 NW 79, 2.7 m of boulder clay, underlying potentially workable glacial lake deposit, graded as a 'clayey' gravel and although potentially workable the till has not been included in the calculation of resources as no other such occurrence is known. Section 63 NE 12 sited on an area of mapped glacial sand and gravel reveals glacial lake deposit near the surface. The upper 0.7 m is a glacial gravel too thin to be considered separately. In section 63 NE 14, where 3.5 m of waste separates an upper and lower deposit of glacial sand and gravel, only the upper 8.4 m (including 2.9 m of obscured mineral) has been considered.

Based on nine Industrial Minerals Assessment Unit boreholes and two natural sections the mean grading of glacial sand and gravel and alluvium is fines 12 per cent, sand 63 per cent, gravel 25 per cent. Further details are shown in Table 10 and Figure 10. The mean thickness of mineral is 11.6 m. Although the mean thickness of overburden for all deposits is 1.5 m, the average thickness in boreholes proving mineral at or near the surface is 0.5 m. The volume of potentially workable mineral, excluding glacial lake deposits, is estimated at 33 million m^3 ± 42 per cent.

A statistical assessment including potentially workable glacial lake deposits appears in Table 2. Mean thicknesses of overburden and mineral are 1.4 m and 12.0 m respectively. The estimated volume of all potentially workable material is 35 million m^3 ± 36 per cent.

Block F

Block F occupies the remainder of the resource map. The following notes, for three sub-blocks, namely F_1, F_2 and F_3, describe the scattered patches of glacial sand and gravel overlying boulder clay, which occur on the higher ground away from the valleys of the Irvine and Avon. Boreholes drilled in the course of this survey and other records indicate that generally boulder clay does not obscure glacial sand and gravel. Locally, areas of potentially workable deposits may occur beneath overburden, but it is not possible to delineate them on the basis of available data. Borehole and grading data are summarised in Table 11 and Figure 11.

Sub-block F_1 The sub-block occupies the ground north of blocks A, B, C and D. Extensive peat bogs form the upland areas of Cameron's Moss [521 425], Wallacegill Muir [544 405], Pley Moss [568 420], Calder Moss [597 407] and Mossmulloch [636 420]. Closer to the valleys of the Irvine and Avon isolated patches of peat overlie boulder clay. The latter is shown by Industrial Minerals Assessment Unit boreholes 53 NE 17, 53 NE 21, 63 NW 60, 64 SW 1 and 64 SE 4 and office records, boreholes 53 NW 44, 53 NW 62, 54 SE 1 and 63 NW 33 to rest on bedrock.

The southerly flowing Glen Water has incised a steep valley, which in places exposes bedrock. The dissected terraces, which flank the valley sides, are developed primarily on boulder clay, as shown by borehole 54 SE 3, which proves 16.6 m of boulder clay on bedrock, but also on glacial sand and gravel as shown by boreholes 53 NE 16 and 54 SE 2, which prove 1.0 m and 3.9 m of mineral respectively, overlying boulder clay on bedrock. North of Laigh Braidley [574 405] sections [5730 4069 and 5750 4066] display glacial sand and gravel interbedded with boulder clay. No other evidence of concealed sand and gravel is known in the sub-block and it is thought that these sections represent a rare localised occurrence. Patches of sand and gravel with infrequent sections exhibiting 1 to 2 m of potentially workable material are found mainly adjacent to the tributaries of the Glen Water.

Evidence from boreholes and sections indicates that the glacial sand and gravel in the vicinity of the Glen Water has an average thickness of 1.6 m. On this basis the inferred volume of mineral will be 1.0 million m^3. Bulk samples from boreholes 53 NE 16, 54 SE 2 and 54 SE 3 have a mean grading of fines 12 per cent, sand 39 per cent, gravel 49 per cent.

Sub-block F_2 The sub-block lies east of blocks C, D and E. Extensive upland stretching northwards from Regal Hill [699 336] to Willochsheugh Moss [695 386] and attaining a maximum altitude of 457 m (1500 ft) above Ordnance Datum at Dungavel Hill is mainly covered by peat and

Table 10. Block E: data from assessment boreholes and exposures - resources in the glacial sand and gravel and alluvium

Borehole No.	Recorded thickness (m)		Mean grading percentage						
	Overburden	Mineral	Fines -1/16 mm	Fine sand -¼+1/16 mm	Medium sand -1+¼ mm	Coarse sand -4+1 mm	Fine gravel -16+4 mm	Coarse gravel -64+16 mm	Cobble gravel +64 mm
63 NW 79	0.3	15.1	8	33	35	8	9	7	trace
63 NE 5	4.7	5.3	26	34	15	6	8	8	3
63 NE 6	8.0	12.1	13	34	22	8	13	8	2
63 NE 7	0.5	15.5	14	39	18	8	9	10	2
*63 NE 13	0	15.5	2	8	21	14	18	33	4
*63 NE 14	0	8.4	6	49	28	5	5	6	1
63 SW 1	0.5	24.5	5	17	29	14	17	15	3
63 SW 2	0.8	4.4	14	12	14	18	21	16	5
63 SE 1	0.4	20.1	21	49	21	2	2	3	2
63 SE 2	0.3	6.2	22	34	14	5	9	9	7
63 SE 3	0.7	7.3	12	24	24	9	13	16	2
Mean	1.5	11.6	12	31	23	9	11	12	2

* natural section

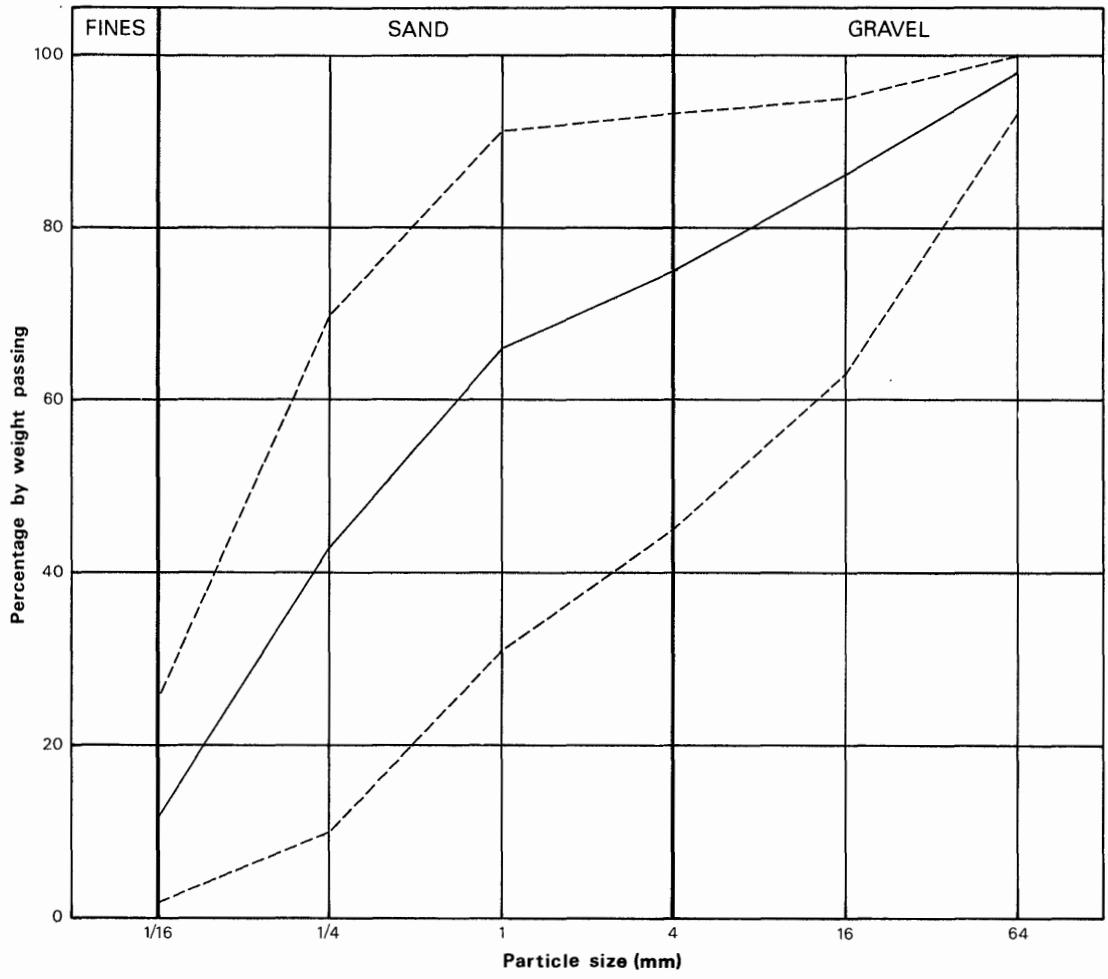


Fig. 10. Grading characteristics of the resources in the glacial sand and gravel and alluvium in block E. (For explanation see Fig. 4.)

Table 11: Block F: data from assessment boreholes - resources in the glacial sand and gravel

Borehole No.	Recorded thickness (m)		Mean grading percentage						
	Overburden	Mineral	Fines -1/16 mm	Fine sand -$\frac{1}{4}$+1/16 mm	Medium sand -1+$\frac{1}{4}$ mm	Coarse sand -4+1 mm	Fine gravel -16+4 mm	Coarse gravel -64+16 mm	Cobble gravel +64 mm
F_1 53 NE 16	0.4	1.0	10	14	23	17	21	15	0
54 SE 2	0.7	3.9	12	11	13	11	21	32	0
Mean	0.5	1.6	12	12	15	12	21	28	0
F_2 63 NE 10	0.5	2.5	11	6	8	11	17	22	25
F_3 53 NW 72	0.3	2.2	38	50	10	1	trace	1	0
53 NW 73	0.3	7.2	9	21	29	10	13	14	4
Mean	0.3	4.7	16	27	25	8	10	11	3
Mean	0.4	2.8	14	20	19	10	14	18	5

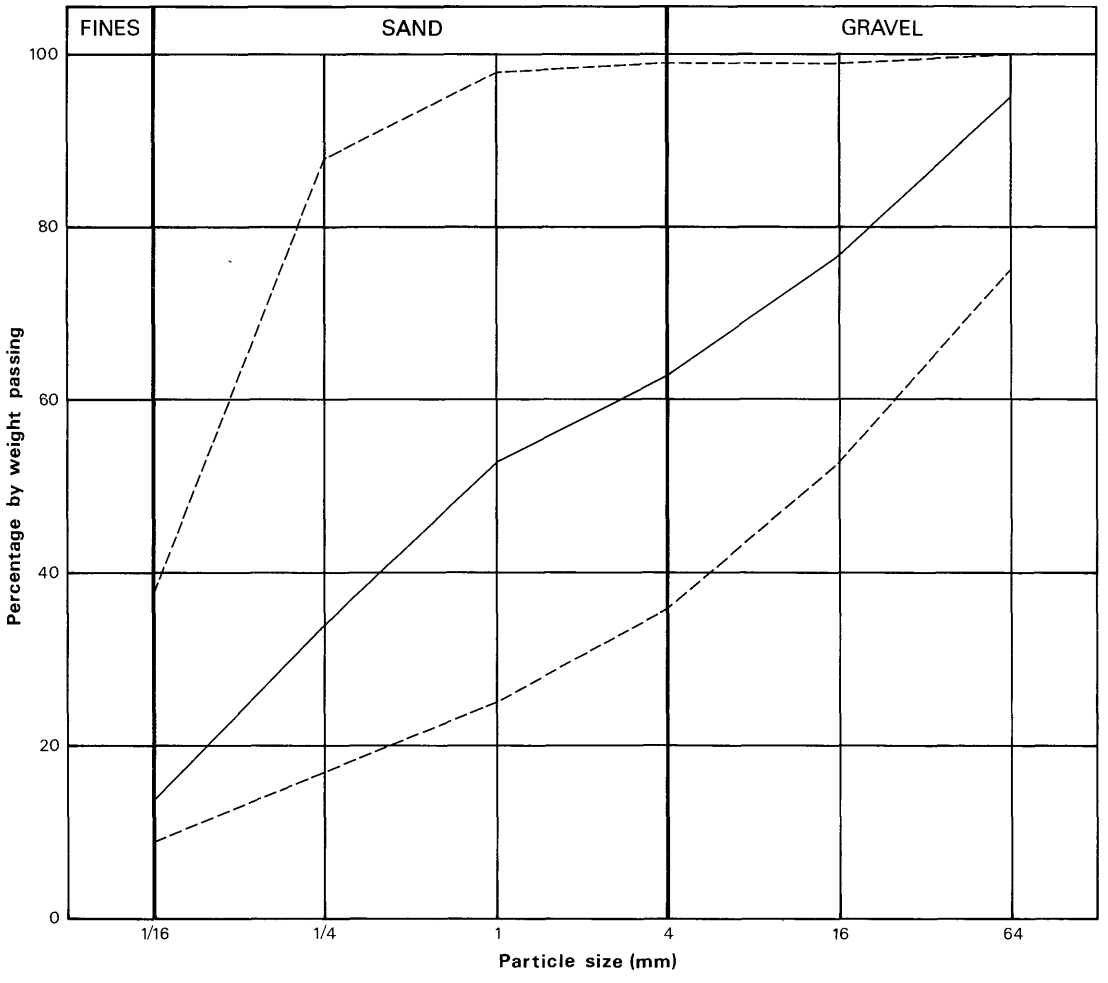


Fig. 11. Grading characteristics of the resources in the glacial sand and gravel in block F. (For explanation see Fig. 4.)

boulder clay. Lower lying ground near the Avon is underlain mainly by boulder clay, covered by small isolated patches of peat and alluvium.

The extent of glacial sand and gravel shown on the resource map results from remapping of the drift deposits carried out after completion of the drilling programme. Older geological surveys indicate extensive spreads of sand and gravel south of the Avon. Boreholes 63 NE 11, 64 SE 10, 64 SE 12 and 64 SE 15 sited to investigate these deposits prove boulder clay of varying thickness overlying bedrock. Of three further boreholes, 64 SE 14 does not show the full thickness of boulder clay, and boreholes 64 SE 13 and 64 SE 17 prove bedrock at the surface indicating the variable thickness of drift. One borehole, 63 NE 10, sited close to the area shown on the resource map to contain glacial sand and gravel, proves 2.5 m of mineral overlying boulder clay on bedrock. Close to the Avon, boreholes 64 SE 11 and 64 SE 16 with 64 SE 10 and 64 SE 12 show that boulder clay generally overlies bedrock, but borehole 63 NE 2 indicates that rarely thin deposits of concealed glacial sand and gravel may be encountered. Sections adjacent to the Avon and Lochar Water show alluvium overlying bedrock.

The mean grading for 2.5 m of glacial sand and gravel proved in borehole 63 NE 10 is 11 per cent fines, 25 per cent sand and 64 per cent gravel. If the thickness of mineral proved in this borehole is representative of the deposits in the vicinity of Lochar Water a volume of 0.5 million m^3 may be inferred.

Sub-block F_3 Sub-block F_3 lies south of blocks A, B, C and E. The upland areas of Distinkhorn [586 330], Anderside Hill [613 333] and Bankend Rig [648 331] are covered by peat or boulder clay. Locally drift cover is thin and bedrock is exposed on the upper slopes at Sornhill [512 344], near Hillhouse at [525 344, 534 355, 543 349], Tulloch Hill [587 350], Watstone Hill [599 349] Cairnsaigh Hill [610 362] and Graystone Hill [620 348]. The Kaims of Avon [605 345 to 619 343] which form a broken, easterly aligned esker ridge about 1 km long and attaining a maximum of 5 m in height, are composed of coarse and fine gravel with sand. South of Newmilns a variable thickness of boulder clay on bedrock is shown by Industrial Minerals Assessment Unit boreholes 53 NW 70 and 53 SW 64 and office records, boreholes 53 NW 13, 53 SW 8, SE 790/17 and SE 906/3. At Stonyhall [525 362] and Middlethird [526 355] small isolated patches of glacial sand and gravel are shown, by boreholes 53 NW 72 and 53 NW 73 which prove 2.2 m and 7.2 m of mineral respectively, to overlie boulder clay. For these deposits, the mean thickness of which is 4.7 m, an inferred volume is 1.5 million m^3. The mean grading is 16 per cent fines, 60 per cent sand and 24 per cent gravel.

Glacial lake deposits of blocks C, D and E Potentially workable glacial lake deposits comprise 'clayey' to 'very clayey' fine sand. In blocks C and D borehole data, records of natural sections and evidence from a working pit have been used to define the resource. The ratio of data points proving potentially workable glacial lake deposits to the total number of data points in the blocks has been taken to determine the areal extent of potentially workable glacial lake deposits.

In the valley of the Avon and northern part of Glengavel, included in blocks C and D, glacial lake deposits were proved in nine and eight boreholes respectively and are displayed in a working pit in block C. Of these data points, six boreholes in block C, two boreholes in block D and the pit proved potentially workable glacial lake deposits beneath other glacial deposits or alluvium or both. Borehole 63 NW 63 proved 2.2 m 'very clayey' fine sand (potentially workable glacial lake deposit) separating an upper 1.6 m gravel (potentially workable glacial sand and gravel) from 1.7 m+ boulder clay. At its base, pit section 63 NW 80C reveals 3.0 m+ 'clayey' fine sand (glacial lake deposit) below glacial sand and gravel. In the remaining seven boreholes, potentially workable glacial lake deposit underlies, overlies or separates waste comprising laminated silt and clay (glacial lake deposit).

In blocks C and D the thickness of potentially workable glacial lake deposit ranges from 1.2 m in borehole 63 NW 76 to 10.9 m in borehole 63 NW 72 and averages 4.1 m. Overburden ranges from 2.6 m in borehole 63 NW 63 to 19.6 m in borehole 63 NW 77 and has an average thickness of 9.8 m.

In block E, of ten boreholes and three natural sections, three data points prove glacial lake deposits but only in two are the deposits considered to be mineral. Borehole 63 NE 5 proves glacial lake deposits separated by 5.3 m of glacial sand and gravel. The upper glacial lake deposit comprises 3.3 m of laminated clay: of the lower deposit, 13 m in thickness, the basal 10.8 m comprising 'clayey sand' is thought to be potentially workable. Section 63 NE 12 demonstrates 5.0 m of 'clayey' sand (glacial lake deposit) underlying 0.7 m of glacial sand and gravel. However, the latter is too thin to be considered separately and has therefore been included with the glacial lake deposit in the assessment. Section 63 NE 14 displays 3.5 m of laminated clay (glacial lake deposit) beneath 8.4 m of glacial sand and gravel, but no potentially workable glacial lake deposit was recorded. An area of concealed potentially workable glacial lake deposits is thought to be co-extensive with an area of buried glacial sand and gravel in the vicinity of Templeland.

Based on nine Industrial Minerals Assessment Unit boreholes, one natural section and one pit section, the mean grading of potentially workable glacial lake deposits in blocks C, D and E is 20 per cent fines, 79 per cent sand and 1 per cent gravel. The fines content ranges from 11 per cent in boreholes 63 NW 74 and 63 NE 5 to 37 per cent in borehole 63 NE 1. The sand content ranges from 62 per cent in borehole 63 NE 1 to 89 per cent in boreholes 63 NW 74 and 63 NE 5. However, the sand fraction is composed predominantly of fine sand which ranges from 55 per cent

Table 12. Blocks C, D and E: data from assessment boreholes and exposures - resources in the glacial lake deposits

Borehole No.	Recorded thickness (m)		Mean grading percentage						
	Overburden	Mineral	Fines -1/16 mm	Fine sand $-\frac{1}{4}+1/16$ mm	Medium sand $-1+\frac{1}{4}$ mm	Coarse sand -4+1 mm	Fine gravel -16+4 mm	Coarse gravel -64+16 mm	Cobble gravel +64 mm
63 NW 61	†16.7	2.0	26	70	4	trace	0	0	0
63 NW 62	†11.6	4.0	35	64	1	trace	0	0	0
63 NW 63	† 2.6	2.2	20	67	10	2	1	0	0
63 NW 72	† 6.1	10.9	21	69	9	1	trace	trace	0
63 NW 74	† 5.2	6.0	11	82	6	1	trace	0	0
63 NW 76	† 4.0	1.2	29	55	15	1	trace	0	0
63 NW '77	†19.6	5.0	22	64	13	1	trace	0	0
+63 NW 80C	†18.7	3.0	19	77	4	trace	trace	0	0
63 NE 1	† 3.3	2.7	37	60	1	1	trace	1	0
63 NE 5	†12.2	10.8	11	71	17	1	trace	0	0
*63 NE 12	nil	5.7	18	66	4	2	4	4	2
Mean	9.1	4.8	20	69	9	1	1	trace	trace

* natural section
\+ pit section
† includes potentially workable glacial sand and gravel or alluvium or both

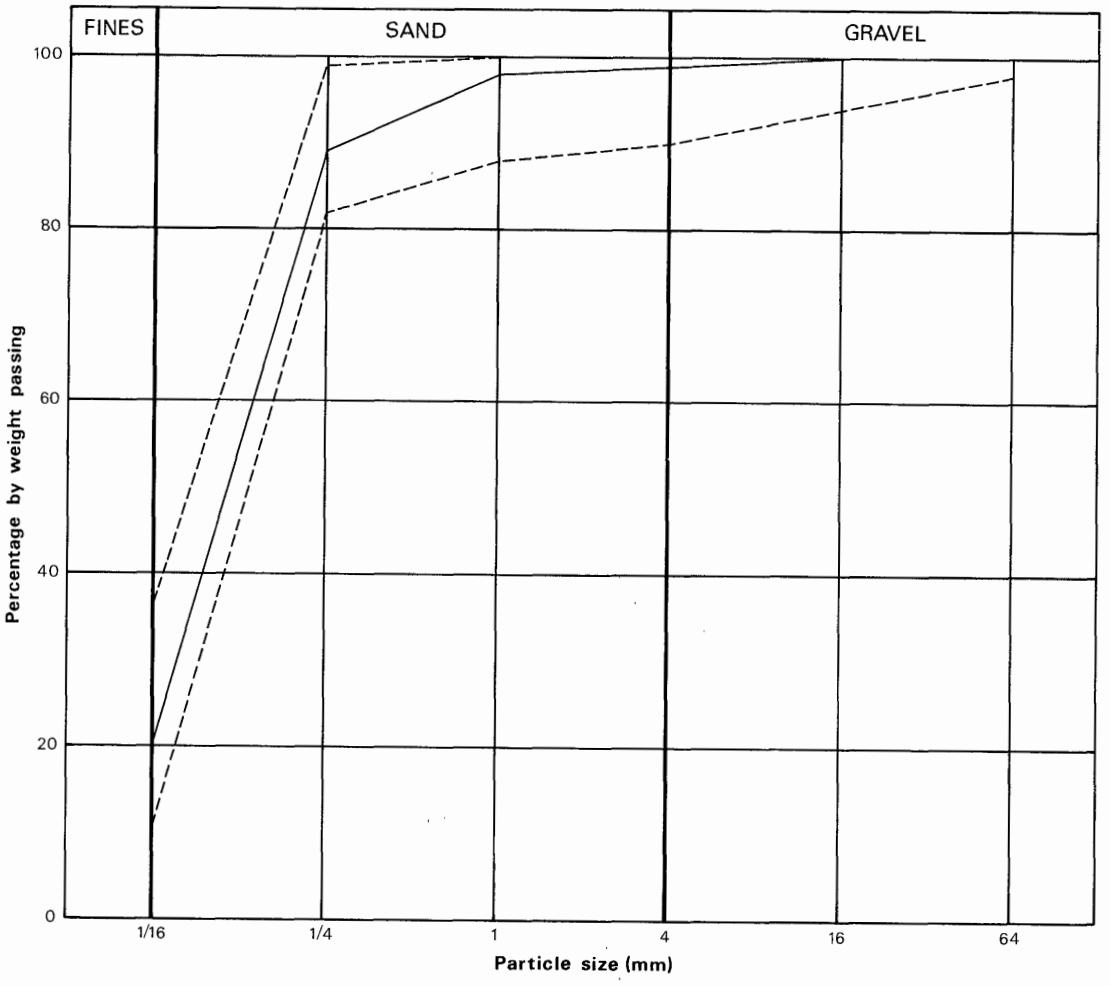


Fig. 12. Grading characteristics of the resources in the glacial lake deposits in blocks C, D and E. (For explanation see Fig. 4.)

in borehole 63 NW 76 to 82 per cent in borehole 63 NW 74. Usually, only trace amounts of gravel are present as shown by Figure 12. Exceptionally, the mean grading of section 63 NE 12 shows 10 per cent gravel due to the consideration of 0.7 m of glacial sand and gravel together with glacial lake deposits.

The mean overburden thickness is 9.1 m and includes sequences of potentially workable glacial sand and gravel or alluvium or both, which are assessed separately. Mineral, of mean thickness 4.8 m, ranges from 1.2 m in borehole 63 NW 76 to 10.9 m in borehole 63 NW 72. The volume is estimated at 15 million $m^3 \pm 48$ per cent.

APPENDIX A: FIELD AND LABORATORY PROCEDURES

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

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

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

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

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

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

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

Detailed records may be consulted at the appropriate offices of the Institute, upon application.

APPENDIX B: STATISTICAL PROCEDURE

Statistical Assessment

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

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

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

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

4. The above relationship may be transposed such that

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

per cent.

11. The application of this procedure to a fictitious area is illustrated in Figs. 13 and 14.

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

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

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

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

APPENDIX C: CLASSIFICATION AND DESCRIPTION OF SAND AND GRAVEL

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

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

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

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

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

Thus it is possible to classify the mineral into one of twelve descriptive categories (see Fig. 15). The procedure is as follows:

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

For example, a deposit grading 11 per cent gravel, 70 per cent sand and 19 per cent fines is classified as 'clayey' pebbly sand. This short description is included in the borehole log (see Note 11, p.37).

Many differing proposals exist for the classification of the grain size of sediments (Atterberg, 1905; Udden, 1914; Wentworth, 1922; Wentworth, 1935; Allen, 1936; Twenhofel, 1937; Lane and others, 1947). As Archer (1970a, b) has emphasised, there is a pressing need for a simple metric scale acceptable to both scientific and engineering interests, for which the class limit sizes correspond closely with certain marked changes in the natural properties of mineral particles. For example, there is an important change in the degree of cohesion between particles at about the 1/16 mm size, which approximates to the generally accepted boundary between silt and sand. These and other requirements are met by a system based on Udden's geometric scale and a simplified form of Wentworth's terminology (Table 13), which is used in this Report.

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

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

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

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

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

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

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

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

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

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

Table 13 Classification of gravel, sand and fines

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

Block Calculation — 1:25 000 Block } Fictitious

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

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

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

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

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

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

Calculation of confidence limits

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

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

$n = 8$

$t = 2.365$

L_V is calculated as

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

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

$$= 20.3$$

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

Fig. 13 Example of resource block assessment: calculations and results

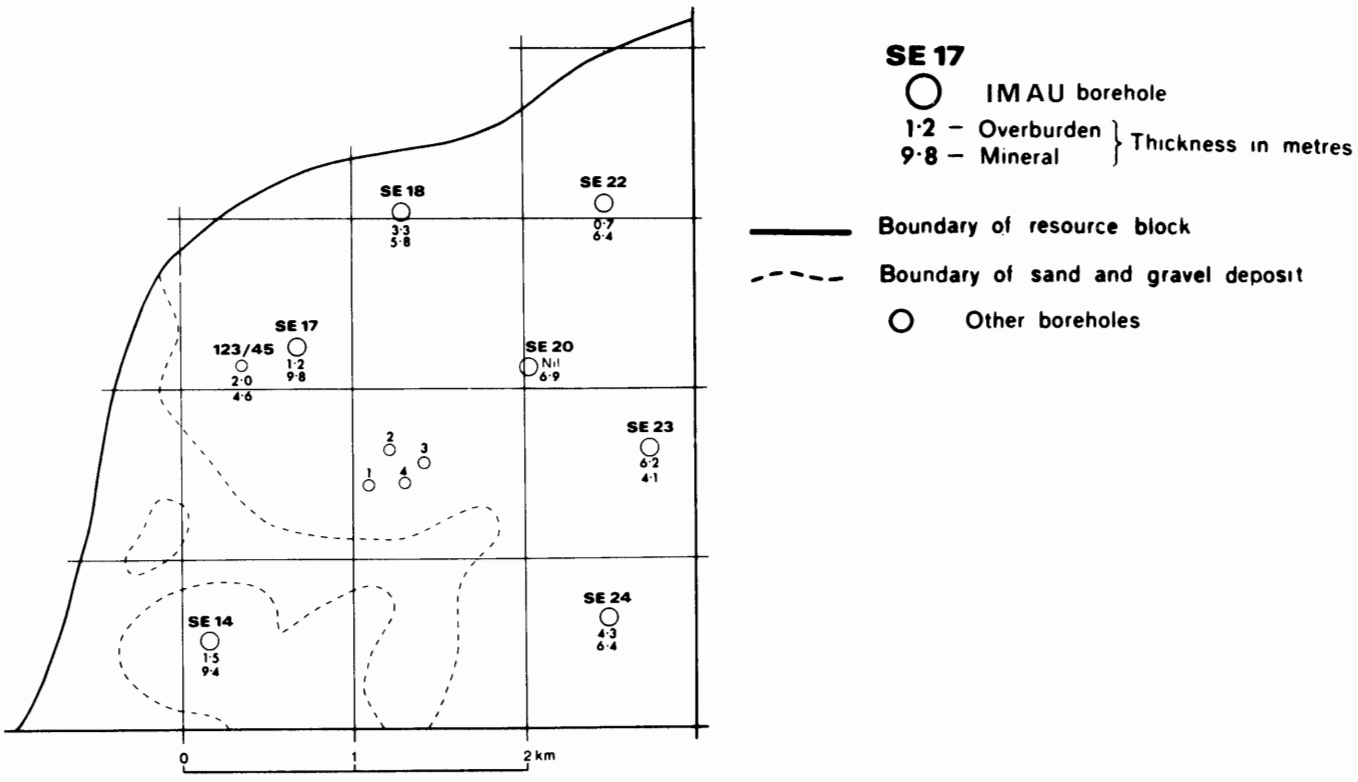
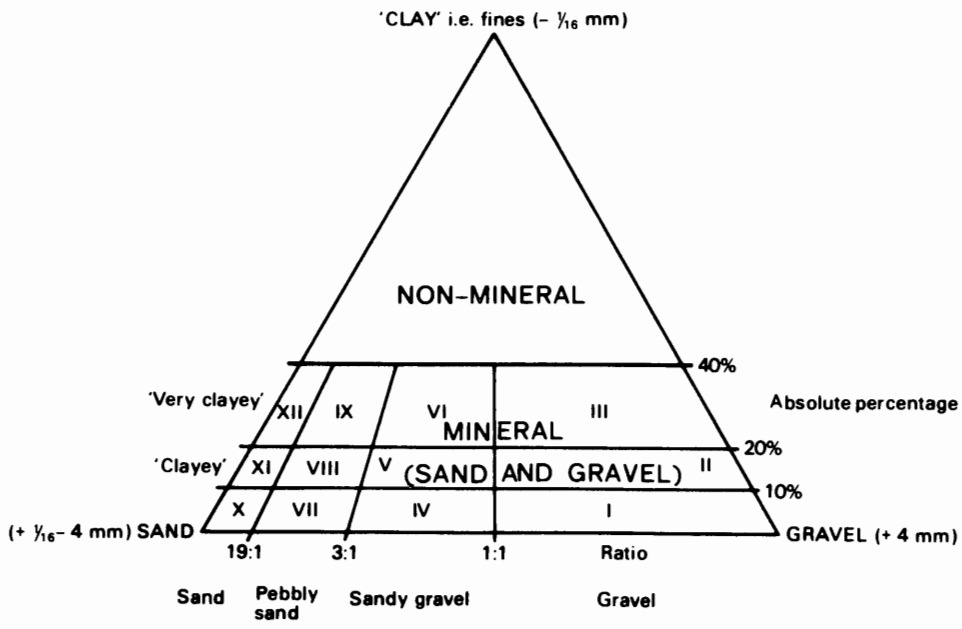


Fig. 14. Example of resource block assessment: map of fictitious block



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

Fig. 15. Diagram showing the descriptive categories used in the classification of sand and gravel

APPENDIX D: EXPLANATION OF THE BOREHOLE RECORD

ANNOTATED EXAMPLE

NS 63 SE 3[1] 6772 3363[2] Powbrone Bridge, Glengavel[3] Block E

Surface level +274.9 m (+902 ft)[4]
Water struck at +272.2 m[5]
Shell, 250 mm diameter[6]
January 1976

Overburden 0.7 m[7]
Mineral 7.3 m
Waste 2.2 m
Bedrock 0.6 m+

LOG

Geological Classification[10]	[11]Lithology	Thickness m	Depth[8] m
	Soil	0.7	0.7
Alluvium on glacial sand and gravel	(a) Gravel Gravel: coarse and fine with cobbles, purple and grey, rounded, sandstone and quartzite Sand: fine to coarse, angular, rock fragments and quartz Fines: mainly clay	2.0	2.7
	(b) 'Clayey' sandy gravel Gravel: fine, rounded, quartz and basalt Sand: fine and medium quartz, micaceous with coaly fragments Fines: clay, light brown	3.7	6.4
	(c) Gravel Gravel: coarse and fine, rounded quartz, greywacke, sandstone and basalt with felsite Sand: fine to coarse, quartz, micaceous with coaly fragments	1.6	8.0
Boulder clay	Clay, light brown, stiff, stony	2.2	10.2
Silurian	Conglomerate, weathered, grey	0.6+[9]	10.8

GRADING

[15]Mean for deposit (a to c)	%	mm	%	[12]Depth below surface (m)	From	To	[13]Bulk Samples Percentages: Fines -1/16	Sand -¼+1/16	Sand -1+¼	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
Gravel	31	+ 64	2	(a)	0.7	1.7	9	10	11	7	13	39	11
		- 64 + 16	16		1.7	2.7	9	13	21	19	18	14	6
		- 16 + 4	13		mean		9	11	16	13	16	27	8
Sand	57	- 4 + 1	9	(b)	2.7	4.4	11	45	34	5	5	trace	0†[14]
		- 1 + ¼	24		4.4	5.2	8	37	43	5	5	2	0†
		- ¼ + 1/16	24		5.2	6.4	31	28	22	5	9	5	0†
					mean		17	38	32	5	6	2	0
Fines	12	- 1/16	12										
				(c)	6.4	7.5	1	9	14	12	24	40	0†
					7.5	8.0	6	4	15	16	25	34	0†
					mean		2	7	15	14	24	38	0

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

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

(a) The number of the 1:25 000 sheet on which the borehole lies, for example NS 63.

(b) The quarter of the 1:25 000 sheet on which the borehole lies and its number in a series for that quarter, for example SE 3.

Thus the full Registration Number is NS 63 SE 3. Usually this is abbreviated to 63 SE 3 in the text.

Natural sections used in the assessment have been registered under the same series. They are distinguished by an asterisk following the Registration Number.

2. The National Grid Reference
All National Grid References in this publication lie within the 100-km square NS. Grid references are given to eight figures, accurate to within 10 m for borehole locations. (In the text, six-figure grid references are used for more approximate locations, for example, for farms).

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

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

5. Groundwater Conditions
If groundwater was present the level at which it was either encountered or statically measured is normally given (in metres above Ordnance Datum).

6. Type of Drill and Date of Drilling
Modified shell and auger rigs were used in this survey. The drilling method, the external diameter of the casing used, and the month and year of completion of the borehole are stated.

7. Overburden, Mineral, Waste and Bedrock
Mineral is sand and gravel which, as part of a deposit, falls within the arbitrary definition of potentially workable material (see p. 1). Mineral thicknesses may include waste partings up to 1.0 m thick, which are excluded in the assessment of resources. In some instances lower deposits of glacial sand and gravel overlain by thick sequences of waste are not considered. Consequently mineral thicknesses given in Tables 4 to 12 may not correspond precisely with the logs. Bedrock is the 'formation', 'country rock' or 'rockhead' below which potentially workable sand and gravel will not be found. Waste is any material other than bedrock or mineral. Where waste occurs between the surface and mineral it is classified as overburden.

8. Thickness and Depth
All measurements were made in metres.

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

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

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

12. Sampling
A continuous series of bulk samples is taken through the thickness of sand and gravel. A new sample is commenced whenever there is an appreciable lithological change within the sand

and gravel or at every 1 m of depth.

13. Grading Results
The results are expressed as per cent by weight retained on British Standard sieves whose aperture sizes are given in millimetres or fractions thereof.

14. Bailed Samples
Fully representative sampling of sand and gravel is difficult to achieve particularly where groundwater levels are high. Comparison between boreholes and adjacent exposures suggests that in borehole samples the proportion of sand may be higher and the proportions of fines and coarse gravel (+16 mm) may be lower. Samples obtained by the bailing technique (that is, from deposits below the water table) are indicated thus: †.

15. Mean Grading
The grading of the full thickness of the mineral deposit identified in the log is the mean of the individual sample gradings weighted by the thicknesses represented, if these vary. The classification used is shown in Table 13. Where two or more distinct units of mineral form continuous sequences, the mean gradings of these are given. Where two or more distinct units of mineral form a continuous sequence separated from another sequence by waste the combined mean grading of the units appears on the left hand side of the log in addition to the mean grading for the full thickness of mineral identified. Each mineral unit is designated by a letter, for example, (a), (b), etc. Samples of sand and gravel, boulder clay and glacial lake deposits with less than 40 per cent by weight passing 1/16 mm, but not considered in the calculation of mean grading are indicated thus: ‡. These samples form small parts of sequences regarded as generally unworkable.

APPENDIX E: LIST OF BOREHOLES AND SECTIONS USED IN THE ASSESSMENT OF RESOURCES

1. Industrial Minerals Assessment Unit Boreholes

Borehole No. by sheet quadrant	Grid references (all lie in 100-km square NS)	Page No.
NS 53 NW		
67	5054 3702	41
68	5059 3554	42
69	5198 3708	43
70	5145 3659	44
71	5228 3779	45
72	5238 3596	46
73	5262 3534	47
74	5353 3692	48
75	5418 3769	48
76	5482 3715	49
NS 53 NE		
12	5503 3769	50
13	5505 3742	51
14	5541 3676	52
15	5594 3670	53-54
16	5769 3940	55
17	5765 3827	56
18	5759 3729	57
19	5702 3723	58
20	5729 3635	59
21	5844 3823	60
22	5820 3722	61
23	5850 3670	62
24	5823 3615	63-64
25	5894 3604	65-66
26	5911 3786	67-68
27	5981 3740	69-70
28	5917 3701	71
29	5965 3691	72-73
30	5966 3617	74
31	5949 3573	75
NS 53 SW		
64	5398 3399	77
NS 54 SE		
2	5673 4059	77
3	5766 4002	78
NS 63 NW		
57	6037 3792	78
58	6018 3680	79
59	6049 3598	80
60	6160 3815	80
61	6120 3768	81-82
62	6163 3672	83
63	6152 3653	84
64	6178 3573	85
65	6249 3711	86
66	6249 3628	87
67	6322 3815	88
68	6340 3765	89-90
69	6396 3695	91
70	6354 3659	92
71	6387 3615	93
72	6453 3926	94
73	6459 3900	95
74	6425 3825	96
75	6487 3748	97
76	6427 3746	98
77	6465 3685	99-100
78	6447 3619	101
79	6493 3557	102-103
NS 63 NE		
1	6545 3900	109
2	6577 3864	110
3	6511 3847	111
4	6525 3700	112
5	6533 3605	113-114
6	6590 3556	115-116

Borehole No. by sheet quadrant	Grid references (all lie in 100-km square NS)	Page No.
NS 63 NE		
7	6544 3537	117
8	6614 3946	118
9	6797 3938	119
10	6855 3972	120
11	6955 3978	121
NS 63 SW		
1	6450 3469	126-127
2	6403 3425	128
NS 63 SE		
1	6580 3459	129
2	6699 3429	130
3	6772 3363	131
NS 64 SW		
1	6494 4068	132
NS 64 SE		
4	6533 4174	132
5	6591 4085	133
6	6614 4162	134
7	6641 4087	135
8	6600 4012	136
9	6717 4196	137
10	6799 4180	138
11	6711 4095	138
12	6853 4218	139
13	6895 4148	139
14	6807 4048	140
15	6888 4037	140
16	6971 4241	141
17	6968 4136	141

2. Industrial Minerals Assessment Unit Sections

Section No. by sheet quadrant	Grid references (all lie in 100-km square NS)	Locality	Page No.
NS 53 NE			
32	5793 3779	Priestland	76
NS 63 NW			
80A	6132 3749	Loudoun Hill	104
80B	6115 3756		105
80C	6114 3747		106
81	6370 3798	South Torfoot	107
82	6454 3925	Snabe	108
NS 63 NE			
12	6527 3619	Templeland	122
13	6512 3572	Bankend	123
14	6563 3527	Laigh Plewland	124-125

APPENDIX F: INDUSTRIAL MINERALS ASSESSMENT UNIT BOREHOLE AND SECTION RECORDS

NS 53 NW 67 5054 3702 Loudoun Castle, Galston Block A

Surface level +47.4 m (+156 ft)
Water struck at +45.0 m
Shell 250 mm and 200 mm diameter
April 1976

Overburden 0.3 m
Mineral 2.8 m
Waste 12.2 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Alluvium	'Clayey' sandy gravel Gravel: fine and coarse with cobbles, rounded to angular, sandstone, basalt and quartz Sand: fine to coarse Fines: clay, mid-brown	2.8	3.1
Glacial lake deposit	Clay, silty, laminated, grey-brown with faint brown laminae	7.2	10.3
Boulder clay	Clay, firm, mottled, brown with reddish tinges, with clasts of basalt, quartz, sandstone, granite and shale	5.0+	15.3

Borehole abandoned due to rock obstruction

GRADING

Mean for Deposit				Depth below surface (m)		Bulk Samples Percentages						
	%	mm	%	From	To	Fines	Sand			Gravel		
						-1/16	-¼+1/16	-1+¼	-4+1	-16+4	-64+16	+64
		+ 64	7	0.3	1.4	16	19	7	12	28	18	0
Gravel	47	- 64 + 16	19	1.4	3.1	13	11	15	14	16	19	12
		- 16 + 4	21	Mean		14	14	12	13	21	19	7
		- 4 + 1	13									
Sand	39	- 1 + ¼	12									
		- ¼ + 1/16	14									
Fines	14	- 1/16	14									

NS 53 NW 68 5059 3554 Cessnock Farm, Galston Block F_3

Surface level +115.6 m (+379 ft)
Water not struck
Shell 200 mm diameter
April 1976

Waste 10.8 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Soil, sandy clay	1.2	1.2
Boulder clay	Clay, stiff, compact, brown becoming grey at depth, with angular to rounded clasts of basalt, grey sandstone and quartz	9.6+	10.8
	Borehole abandoned due to rock obstruction		

NS 53 NW 69 5198 3708 Hag Bridge, Newmilns Block A

Surface level +54.6 m (+179 ft)
Groundwater level +47.0 m
Shell 250 mm diameter
March 1976

Overburden 0.4 m
Mineral 1.1 m
Waste 11.0 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Soil, sandy	0.4	0.4
Alluvium	Gravel Gravel: fine and coarse with cobbles, rounded, yellow and grey sandstone, felsite and basalt Sand: medium to coarse with fine, subrounded, rock fragments	1.1	1.5
Glacial lake deposit	Silt, laminated, dark grey, micaceous, stiff	9.0	10.5
Boulder clay	Clay, sandy, red-brown, with rounded igneous clasts	2.0+	12.5
	Borehole abandoned due to subsidence		

GRADING

Mean for Deposit				Depth below surface (m)		Bulk Samples Percentages						
	%	mm	%	From	To	Fines	Sand			Gravel		
						-1/16	-¼+1/16	-1+¼	-4+1	-16+4	-64+16	+64
		+ 64	20	0.4	1.5	6	5	10	12	20	27	20
Gravel	67	- 64 + 16	27									
		- 16 + 4	20									
		- 4 + 1	12									
Sand	27	- 1 + ¼	10									
		- ¼ + 1/16	5									
Fines	6	- 1/16	6									

NS 53 NW 70 5145 3659 Little Maxwood Farm, Galston Block F_3

Surface level +64.4 m (+211 ft)
Ground water level +62.2 m
Shell 250 mm diameter
April 1976

Waste 7.4 m
Bedrock 0.4 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Made ground	3.4	3.4
Boulder clay	Clay, sandy at top, mid-brown becoming grey-brown at depth, with angular to subangular red and grey sandstones, igneous rock fragments and coal	4.0	7.4
Carboniferous (Calciferous Sandstone Measures)	Sandstone, fine grained, micaceous, thinly bedded, dark reddish purple	0.4+	7.8

NS 53 NW 71 5228 3779 Woodhead Farm, Newmilns Block F_1

Surface level +113.0 m (+371 ft)
Ground water level +100.9 m
Shell 250 mm diameter
April 1976

Waste 13.9 m
Bedrock 0.3 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Clay, reddish brown, pebbly	1.5	1.5
Boulder clay	Clay, red-brown becoming grey below 2.0 m, stiff, compact, with clasts of black shale, basalt, yellow sandstone and coal	5.5	7.0
Glacial sand and gravel	'Clayey' sandy gravel Gravel: fine to coarse, subrounded to angular, basalt and shale with sandstone Sand: fine to coarse, shale fragments Fines: clay	1.0	8.0
Boulder clay	Clay, stiff, dark grey, with clasts of basalt and shale	2.6	10.6
Glacial sand and gravel	'Clayey' gravel with bands of boulder clay Gravel: fine to coarse with cobbles, subrounded to angular, basalt Sand: fine to coarse, rock fragments Fines: clay	2.9	13.5
Boulder clay	Clay, stiff, dark grey-brown with clasts of basalt and sandstone	0.4	13.9
Carboniferous (Calciferous Sandstone Measures)	Sandstone, yellowish green, with brown and black streaks, very weathered	0.3+	14.2

GRADING

Depth below surface (m) From	To	Bulk Samples Percentages Fines	Sand			Gravel		
		-1/16	-¼+1/16	-1+¼	-4+1	-16+4	-64+16	+64
7.0	8.0	15	12	19	23	16	15	0 ‡
10.6	11.5	9	9	8	12	39	23	0 ‡
11.5	12.4	6	7	11	10	18	30	18†‡
12.4	13.5	18	12	9	9	20	25	7†‡

‡ Non-mineral: not considered in calculation of mean grading

NS 53 NW 72 5238 3596 Stoneyhall Farm, Newmilns Block F_3

Surface level +149.4 m (+490 ft)
Water not struck
Shell 250 mm diameter
April 1976

Overburden 0.3 m
Mineral 2.2 m
Waste 5.2 m
Bedrock <0.1 m

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Glacial sand and gravel	'Very clayey' sand Sand: fine with medium Fines: clay, yellow and brown	2.2	2.5
Boulder clay	Clay, dark brown, with clasts of quartz, igneous material and sandstone	5.2	7.7
Carboniferous (Calciferous Sandstone Measures)	Basalt, fine grained, porphyritic, amygdaloidal, purple-grey	<0.1	7.7

GRADING

Mean for Deposit

	%	mm	%
		+ 64	0
Gravel	1	- 64 + 16	1
		- 16 + 4	trace
		- 4 + 1	1
Sand	61	- 1 + $\frac{1}{4}$	10
		- $\frac{1}{4}$ + 1/16	50
Fines	38	- 1/16	38

Depth below surface (m) From	To	Bulk Samples Percentages Fines -1/16	Sand -$\frac{1}{4}$+1/16	Sand -1+$\frac{1}{4}$	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
0.3	1.3	38	47	11	1	1	2	0
1.3	2.5	37	52	10	1	trace	0	0
Mean		38	50	10	1	trace	1	0

NS 53 NW 73 5262 3534 Middle Third Farm, Newmilns Block F_3

Surface level +191.2 m (+627 ft)
Water not struck
Shell 250 mm and 200 mm diameter
April 1976

Overburden 0.3 m
Mineral 7.2 m
Waste 13.5 m+

LOG

Geological Classification		Lithology	Thickness m	Depth m
		Loam, brown	0.3	0.3
Glacial sand and gravel	(a)	'Clayey' sandy gravel Gravel: fine to coarse with cobbles, subrounded, grey and red sandstones and igneous rocks Sand: fine to coarse, rock fragments and quartz, yellow to orange Fines: clay	5.2	5.5
	(b)	Sand Sand: fine to medium, quartz and rock fragments, orange	2.0	7.5
Boulder clay		Clay, stiff, brown, sandy, with angular clasts of varied igneous composition, becoming very compact at depth	13.5+	21.0
		Borehole abandoned due to rock obstruction		

GRADING

Mean for Deposit (a&b)	%	mm	%		Depth below surface (m) From	To	Bulk Samples Percentages Fines -1/16	Sand -$\frac{1}{4}$+1/16	Sand -1+$\frac{1}{4}$	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
		+ 64	4	(a)	0.3	1.4	7	11	21	14	16	19	12
Gravel	31	- 64 + 16	14		1.4	2.4	13	12	15	11	17	25	7
		- 16 + 4	13		2.4	3.5	13	13	12	10	24	28	0
					3.5	4.5	12	14	26	12	17	19	0
		- 4 + 1	10		4.5	5.5	9	21	32	11	11	6	10
Sand	60	- 1 + $\frac{1}{4}$	29		Mean		11	14	21	12	17	19	6
		- $\frac{1}{4}$ + 1/16	21										
				(b)	5.5	6.5	5	37	51	5	1	1	0
Fines	9	- 1/16	9		6.5	7.5	6	37	49	5	2	1	0
					Mean		5	37	50	5	2	1	0

NS 53 NW 74 5353 3692 Mount Pleasant, Newmilns Urban area

Surface level +95.6 m (+314 ft)
Water not struck
Shell 250 mm and 200 mm diameter
May 1976

Waste 18.5 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Made ground	0.8	0.8
Boulder clay	Clay, sandy, silty, soft, becoming pebbly at depth with cobbles and boulders of basalt with sandstone and vein quartz	4.4	5.2
Glacial lake deposit	Silt, firm to stiff, clayey, olive-grey to dark brownish grey, with frequent laminae of fine sand and thin bands of fine to coarse gravel	13.3+	18.5

NS 53 NW 75 5418 3769 Dalwhatswood Farm, Newmilns Urban area

Surface level +122.4 m (+402 ft)
Water not struck
Shell 250 mm and 200 mm diameter
April 1976

Waste 12.3 m
Bedrock <0.1 m

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Soil, pebbly clay	1.0	1.0
? Boulder clay	Clay, sandy, stiff, orange-brown, with basalt pebbles	0.7	1.7
Glacial lake deposit	Clay, silty, laminated, dark grey, with rare fine sand laminae and rare pebbles	9.7	11.4
Boulder clay	Clay, stiff, compact, grey, with subangular to angular clasts of shale, red sandstone, basalt and fragments of coal	0.9	12.3
Carboniferous (Calciferous Sandstone Measures)	Basalt, porphyritic, dark grey	<0.1	12.3

NS 53 NW 76 | 5482 3715 | Waterhaughs, Darvel | Block A

Surface level+77.3 m (+254 ft)
Ground water level +76.1 m
Shell 250 mm diameter
March 1976

Overburden 0.6 m
Mineral 4.1 m
Bedrock 0.3 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Soil	0.6	0.6
Alluvium	Gravel Gravel: fine and coarse with cobbles, well rounded with angular, basalt Sand: coarse with fine and medium, subrounded to subangular, quartz and igneous rock fragments	4.1	4.7
Carboniferous (Calciferous Sandstone Measures)	Basalt, blue-grey, weathered, becoming hard at depth	0.3+	5.0

GRADING

Mean for Deposit				Depth below surface (m)		Bulk Samples Percentages						
	%	mm	%	From	To	Fines	Sand			Gravel		
						-1/16	-¼+1/16	-1+¼	-4+1	-16+4	-64+16	+64
		+ 64	10	0.6	1.5	6	7	8	9	19	37	14†
Gravel	65	- 64 + 16	28	1.5	2.5	4	5	10	21	23	23	14†
		- 16 + 4	27	2.5	3.5	4	4	8	17	35	28	4†
				3.5	4.7	5	4	11	17	28	26	9†
		- 4 + 1	16	Mean		5	5	9	16	27	28	10
Sand	30	- 1 + ¼	9									
		- ¼ + 1/16	5									
Fines	5	- 1/16	5									

Surface level +134.0 m (+440 ft)
Water not struck
Shell 250 mm and 200 mm diameter
April 1976

Overburden 10.8 m
Mineral 13.0 m
Waste 1.2 m+

LOG

Geological Classification		Lithology	Thickness m	Depth m
		Made ground	0.3	0.3
? Boulder clay		Clay, laminated, grey, orange and brown, some small pebbles	1.2	1.5
Boulder clay		Clay, sandy with clasts, dark brown, uncompacted at top: varied pebble shape and composition	4.2	5.7
		Clay, laminated, chocolate-brown with silt bands	0.3	6.0
		Clay, sandy, pebbly with cobbles, dark brown, compact: clasts mainly igneous	4.8	10.8
Glacial sand and gravel	(a)	'Clayey' sand Gravel: rare, fine, subangular to well rounded, sandstone and felsite Sand: fine with medium, rounded to well rounded, quartz with rock fragments and feldspar; detrital coal common Fines: silt	5.0	15.8
Glacial lake deposit	(b)	'Clayey' sand Sand: fine, quartz, light brown, with coal fragments Fines: silt	8.0	23.8
		Silt, sandy, micaceous, dark grey	1.2+	25.0

GRADING

Mean for Deposit

(a&b)	%	mm	%
Gravel trace		+ 64	0
		64 + 16	trace
		- 16 + 4	trace
		- 4 + 1	trace
Sand	84	- 1 + $\frac{1}{4}$	12
		- $\frac{1}{4}$ + 1/16	72
Fines	16	- 1/16	16

Bulk Samples Percentages

	Depth below surface (m) From	To	Fines -1/16	Sand -$\frac{1}{4}$+1/16	Sand -1+$\frac{1}{4}$	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
(a)	10.8	11.8	23	55	20	1	1	0	0†
	11.8	12.8	18	61	20	1	trace	0	0†
	12.8	13.8	13	68	13	3	3	trace	0†
	13.8	14.8	7	68	24	1	0	0	0†
	14.8	15.8	5	65	30	trace	0	0	0†
	Mean		13	64	21	1	1	trace	0†
(b)	15.8	16.8	15	79	6	trace	0	0	0†
	16.8	17.8	13	82	5	trace	0	0	0†
	17.8	18.8	19	78	3	trace	0	0	0†
	18.8	19.8	24	73	3	trace	0	0	0†
	19.8	20.8	11	83	6	trace	0	0	0†
	20.8	21.8	11	82	7	trace	0	0	0†
	21.8	22.8	16	75	9	trace	0	0	0†
	22.8	23.8	31	64	5	trace	0	0	0†
	Mean		17	77	6	trace	0	0	0†

NS 53 NE 13 | 5505 3742 | Gowanbank, Darvel | Block A

Surface level +106.0 m (+348 ft)
Water struck at +101.4 m
Shell 250 mm and 200 mm diameter
March 1976

Overburden 2.4 m
Mineral 5.6 m
Waste 16.0 m+

LOG

Geological Classification		Lithology	Thickness m	Depth m
		Soil, sandy loam, light brown	0.6	0.6
Glacial lake deposit		Silt, sandy, yellow-brown with mid to chocolate-brown clay	1.8	2.4
	(a)	'Very clayey' sand with thin silt bands Sand: fine, brown Fines: silt	3.1	5.5
Glacial sand and gravel	(b)	'Clayey' sandy gravel Gravel: fine to coarse with cobbles Sand: fine, brown	2.5	8.0
Glacial lake deposit		Silt, sandy, brown, with 'very clayey' fine sand from 9.0 to 10.0 m and 11.0 to 12.0 m, becoming finer at depth with clay bands	16.0+	24.0

Borehole abandoned due to rising sand

GRADING

Mean for Deposit (a&b)	%	mm	%		Depth below surface (m) From	To	Bulk Samples Percentages: Fines -1/16	Sand -¼+1/16	Sand -1+¼	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
		+ 64	7	(a)	2.4	3.5	34	59	2	trace	1	4	0
Gravel	20	- 64 + 16	10		3.5	4.5	23	68	8	1	0	0	0
		- 16 + 4	3		4.5	5.5	35	60	3	1	trace	1	0†
					Mean		31	62	4	trace	1	2	0
		- 4 + 1	2										
Sand	57	- 1 + ¼	8	(b)	5.5	7.0	16	32	9	4	5	12	22†
		- ¼ + 1/16	47		7.0	8.0	10	23	15	4	11	32	5†
					Mean		13	29	12	4	7	20	15
Fines	23	- 1/16	23										
					9.0	10.0	28	67	4	1	0	0	0† ‡
					11.0	12.0	23	73	4	0	0	0	0† ‡

‡ Non-mineral: not considered in calculation of mean grading

Surface level +128.3 m (+421 ft)
Ground water level +115.3 m
Shell 250 mm and 200 mm diameter
March 1976

Overburden 0.3 m
Mineral 4.5 m
Waste 12.0 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Soil, sandy clay	0.3	0.3
Glacial sand and gravel	'Clayey' sandy gravel Gravel: coarse and fine with rare cobbles, subrounded to rounded basalt. Sand: fine and medium with coarse, subangular, rock fragments and quartz, yellowish red Fines: clay	4.5	4.8
Boulder clay	Clay, compact, stiff in parts, grey with subrounded clasts of basalt	9.9	14.7
Glacial sand and gravel	Pebbly sand Gravel: fine and coarse, subrounded, basalt with felsite, grey sandstone and quartz Sand: fine and medium with coarse, quartz and rock fragments, with coal fragments	2.1+	16.8
	Borehole abandoned due to rock obstruction		

GRADING

Mean for Deposit %	mm	%	Depth below surface (m) From	To	Bulk Samples Percentages Fines -1/16	Sand -¼+1/16	Sand -1+¼	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
	+ 64	1	0.3	1.3	16	26	22	12	13	4	7
Gravel 26	- 64 + 16	11	1.3	2.2	16	26	18	13	12	15	0
	- 16 + 4	14	2.2	3.2	10	29	19	13	17	12	0
			3.2	4.2	17	26	18	12	14	13	0
	- 4 + 1	12	4.2	4.8	25	27	17	10	11	10	0
Sand 58	- 1 + ¼	19	Mean		16	27	19	12	14	11	1
	- ¼ + 1/16	27									
			14.7	15.9	8	63	23	5	1	0	0 † ‡
Fines 16	- 1/16	16	15.9	16.8	4	39	17	8	18	14	0 † ‡

‡ Non-mineral: not considered in calculation of mean grading

NS 53 NE 15 | 5594 3670 | Birkhill Cottage, Darvel | Block B

Surface level +147.7 m (+485 ft)
Water not struck
Shell 250 mm and 200 mm diameter
April 1976

Overburden 0.7 m
Mineral 1.9 m
Waste 8.4 m
Mineral 7.9 m
Waste 4.5 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Made ground	0.7	0.7
Glacial sand and gravel	(a) 'Very clayey' sandy gravel Gravel: fine and coarse with cobbles, subrounded, sandstone with felsite Sand: fine and medium with coarse, quartz and rock fragments Fines: silt	1.9	2.6
Boulder clay	Clay, stiff, compact, red-brown becoming grey at depth, with rounded clasts of sandstone and basalt	8.4	11.0
Glacial sand and gravel	(b) 'Very clayey' pebbly sand with thin bands of laminated, pale brown clay and red-brown sandy boulder clay from 12.0 to 12.9 m and 14.0 to 15.0 m Gravel: fine and coarse with rare cobbles, subrounded, basalt Sand: fine and medium with coarse, quartz, micaceous, yellow Fines: clay, red-brown	4.0	15.0
	(c) 'Very clayey' sandy gravel Gravel: fine and coarse with rare cobbles, subrounded, basalt, quartzite, quartz and sandstone Sand: fine to coarse, rock fragments Fines: clay	3.9	18.9
Boulder clay	Clay, stiff, compact, dark grey, with angular to subrounded clasts of basalt and coal	4.5+	23.4
	Borehole abandoned due to rock obstruction		

Mean for Deposit (b&c)	%	mm	%		Depth below surface (m) From	To	Bulk Samples Percentages Fines -1/16	Sand -¼+1/16	Sand -1+¼	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
		+ 64	0	(a)	0.7	1.7	16	30	11	6	8	16	13
Gravel	25	- 64 + 16	14		1.7	2.6	25	31	12	6	9	17	0
		- 16 + 4	11		Mean		21	30	12	6	8	16	7
		- 4 + 1	7	(b)	11.0	12.0	19	52	25	1	1	2	0
Sand	53	- 1 + ¼	16		12.0	12.9	Clay						
		- ¼ + 1/16	30		12.9	14.0	29	37	28	1	2	3	0
					14.0	15.0	Clay						
Fines	22	- 1/16	22		Mean		24	45	26	1	2	2	0
(a to c)				(c)	15.0	16.0	26	47	9	3	6	9	0
					16.0	17.0	13	15	13	10	19	30	0
		+ 64	1		17.0	18.0	11	9	12	19	26	23	0
Gravel	26	- 64 + 16	15		18.0	18.9	35	17	11	7	11	19	0
		- 16 + 4	10		Mean		21	22	11	10	16	20	0
		- 4 + 1	7										
Sand	52	- 1 + ¼	15										
		- ¼ + 1/16	30										
Fines	22	- 1/16	22										

NS 53 NE 16 | 5769 3940 | Little Glen Farm, Darvel | Block F_1

Surface level +200.3 m (+657 ft)
Ground water level +192.5 m
Shell 250 mm and 200 mm diameter
March 1976

Overburden 0.4 m
Mineral 1.0 m
Waste 13.2 m
Bedrock <0.1 m

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
Glacial sand and gravel	'Clayey' sandy gravel Gravel: fine and coarse, angular to subrounded, yellow sandstone and basalt with felsite and quartz Sand: medium and coarse with fine, subangular, rock fragments and quartz Fines: clay	1.0	1.4
Boulder clay	Clay, red-brown becoming grey below 1.7 m, very compact, sandy with clasts of subrounded basalt and sandstone and fragments of shale	13.2	14.6
Carboniferous (Calciferous Sandstone Measures)	Basalt, porphyritic, black	<0.1	14.6

GRADING

Mean for Deposit					Depth below surface (m)		Bulk Samples Percentages						
	%	mm	%		From	To	Fines	Sand			Gravel		
							-1/16	$-\frac{1}{4}+1/16$	$-1+\frac{1}{4}$	-4+1	-16+4	-64+16	+64
		+ 64	0		0.4	1.4	10	14	23	17	21	15	0
Gravel	36	- 64 + 16	15										
		- 16 + 4	21										
		- 4 + 1	17										
Sand	54	- 1 + $\frac{1}{4}$	23										
		- $\frac{1}{4}$ + 1/16	14										
Fines	10	- 1/16	10										

NS 53 NE 17 5765 3827 Leeloan, Darvel Block F_1

Surface level +152.4 m (+500 ft)
Ground water level +142.1 m
Shell 250 mm and 200 mm diameter
March 1976

Waste 11.2 m
Bedrock 0.3 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Soil, red-brown clay, silty	1.2	1.2
Boulder clay	Clay, stiff, mottled, red-brown becoming dark brown at depth, with angular to rounded clasts of basalt, red and yellow sandstones and coal fragments	5.4	6.6
	Clay, stiff, silty, grey-brown to grey, with fine sand laminae and clasts of weathered basalt	4.6	11.2
Carboniferous (Calciferous Sandstone Measures)	Basalt, porphyritic, grey-green, weathered	0.3+	11.5

Surface level +112.9 m (+370 ft)
Water struck at +109.9 m
Shell 250 mm and 200 mm diameter
April 1976

Overburden 0.3 m
Mineral 3.7 m
Waste 0.9 m
Mineral 4.1 m
Bedrock 0.4 m+

LOG

Geological Classification		Lithology	Thickness m	Depth m
		Soil	0.3	0.3
Alluvium	(a)	'Clayey' sandy gravel becoming 'very clayey' and sandy below 3.0 m Gravel: fine and coarse with cobbles, subangular to rounded, with platy, igneous rocks, sandstone and quartz Sand: fine to coarse, quartz Fines: silt	3.7	4.0
		Silt, faintly laminated, grey	0.9	4.9
Glacial sand and gravel	(b)	Gravel Gravel: coarse and cobbles with fine, subangular and rounded, basalt and yellow sandstone Sand: fine to coarse	4.1	9.0
Carboniferous (Calciferous Sandstone Measures)		Sandstone, weathered at top, fine grained, grey, with thin carbonaceous laminae and orange-brown iron nodules	0.4+	9.4

GRADING

Mean for Deposit				Depth below surface (m)		Bulk Samples Percentages						
	%	mm	%	From	To	Fines	Sand			Gravel		
(a&b)						-1/16	-¼+1/16	-1+¼	-4+1	-16+4	-64+16	+64
		+ 64	22 (a)	0.3	1.3	15	8	11	11	17	17	21
Gravel	59	- 64 + 16	24	1.3	2.3	14	9	13	15	22	27	0
		- 16 + 4	13	2.3	3.0	10	9	10	12	15	44	0
				3.0	4.0	35	49	10	2	3	1	0†
		- 4 + 1	9	Mean		19	20	11	9	14	20	7
Sand	30	- 1 + ¼	8									
		- ¼ + 1/16	13 (b)	4.9	5.9	1	4	1	4	14	22	54†
				5.9	6.9	3	3	2	6	5	20	61†
Fines	11	- 1/16	11	6.9	7.9	2	10	4	8	14	39	23†
				7.9	9.0	7	11	13	17	13	29	10†
				Mean		3	7	5	9	12	27	37

NS 53 NE 19 5702 3723 Greenbank Farm, Darvel Block B

Surface level +141.3 m (+464 ft)
Ground water level +129.5 m
Shell, 250 mm and 200 mm diameter
April 1976

Overburden 1.2 m
Mineral 1.8 m
Waste 13.5 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Soil	0.6	0.6
Boulder clay	Clay, sandy, mottled, orange-brown and light grey, with clasts of quartz, basalt and sandstone	0.6	1.2
Glacial sand and gravel	'Clayey' gravel Gravel: coarse with fine and cobbles, mainly basalt Sand: coarse to fine Fines: silt and clay, brown	1.8	3.0
Boulder clay	Clay, sandy, silty, with well rounded clasts, brown and grey: 'very clayey' sand from 12.5 to 13.2 m	11.8	14.8
Glacial sand and gravel	'Clayey' pebbly sand Gravel: coarse and fine, well rounded Sand: fine with medium Fines: silt	1.7+	16.5
	Borehole abandoned due to rock obstructing casing at 7.0 m		

GRADING

Mean for Deposit %	mm	%	Depth below surface (m) From	To	Bulk Samples Percentages Fines -1/16	Sand -¼+1/16	Sand -1+¼	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
	+ 64	9	1.2	2.3	20	13	9	8	13	37	0
Gravel 58	- 64 + 16	36	2.3	3.0	7	7	6	9	14	35	22
	- 16 + 4	13	Mean		15	11	8	8	13	36	9
	- 4 + 1	8	12.5	13.2	30	52	16	2	0	0	0† ‡
Sand 27	- 1 + ¼	8									
	- ¼ + 1/16	11	14.8	15.9	19	52	23	1	2	3	0† ‡
			15.9	16.5	18	57	22	1	1	1	0† ‡
Fines 15	- 1/16	15									

‡ Non-mineral: not considered in calculation of mean grading

NS 53 NE 20 5729 3635 Auchenbart Farm, Darvel Block B

Surface level +192.6 m (+632 ft)
Ground water level +189.3 m
Shell 250 mm diameter
April 1976

Overburden 0.4 m
Mineral 7.7 m
Bedrock 0.3 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
Glacial sand and gravel	'Clayey' gravel with silt parting from 5.2 to 6.1 m Gravel: fine and coarse with cobbles, mainly subrounded to subangular, basalt, sandstone and some felsite and coal Sand: fine to coarse, angular, rock fragments quartz and coal Fines: silt and clay	7.7	8.1
Carboniferous (Calciferous Sandstone Measures)	Basalt, grey	0.3+	8.4

GRADING

Mean for Deposit				Depth below surface (m)		Bulk Samples Percentages						
	%	mm	%	From	To	Fines	Sand			Gravel		
						-1/16	-$\frac{1}{4}$+1/16	-1+$\frac{1}{4}$	-4+1	-16+4	-64+16	+64
		+ 64	7	0.4	1.5	16	9	10	13	29	16	7
Gravel	54	- 64 + 16	22	1.5	2.5	21	8	9	15	33	14	0
		- 16 + 4	25	2.5	3.5	18	15	14	16	15	12	10
				3.5	4.5	8	4	4	13	31	32	8 †
		- 4 + 1	14	4.5	5.2	9	1	2	10	22	28	28 †
Sand	33	- 1 + $\frac{1}{4}$	10	5.2	6.1	Silt						
		- $\frac{1}{4}$ + 1/16	9	6.1	7.1	11	12	8	14	25	26	4 †
				7.1	8.1	5	15	19	15	20	26	0 †
Fines	13	- 1/16	13	Mean		13	9	10	14	25	22	7

Surface level +178.6 m (+586 ft)
Ground water level +174.9 m
Shell 250 mm and 200 mm diameter
March 1976

Waste 6.5 m
Bedrock <0.1 m

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Soil, brown clay	0.4	0.4
Boulder clay	Clay, sandy, red-brown, with angular to rounded clasts of fine grained basalt, sandstone, shale and quartz	2.6	3.0
	Clay, stiff, compact, grey, with sub-angular to subrounded clasts of basalt and shale	2.0	5.0
	Clay, sandy, compact, red-brown	1.5	6.5
Carboniferous (Calciferous Sandstone Measures)	Basalt, grey, porphyritic	<0.1	6.5

NS 53 NE 22 | 5820 3722 | Bransfield Farm, Darvel | Block B

Surface level +128.0 m (+420 ft)
Ground water level +124.0 m
Shell 300 mm, 250 mm and 200 mm diameter
October 1975

Overburden 0.5 m
Mineral 8.5 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Soil and brown sandy clay	0.5	0.5
Glacial sand and gravel	'Clayey' sandy gravel Gravel: coarse and fine with cobbles, angular to subrounded, basalt, purple sandstone, quartzite and quartz with porphyry Sand: fine with coarse and medium, rock fragments and quartz, micaceous with coaly fragments Fines: clay with silt	8.5+	9.0
	Borehole abandoned due to rising sand		

GRADING

Mean for Deposit

	%	mm	%
		+ 64	4
Gravel	42	- 64 + 16	19
		- 16 + 4	19
		- 4 + 1	11
Sand	45	- 1 + $\frac{1}{4}$	12
		- $\frac{1}{4}$ + 1/16	22
Fines	13	- 1/16	13

Depth below surface (m) From	To	Bulk Samples Percentages Fines -1/16	Sand -$\frac{1}{4}$+1/16	-1+$\frac{1}{4}$	-4+1	Gravel -16+4	-64+16	+64
0.5	1.75	10	10	19	12	18	20	11
1.75	2.6	7	8	14	11	19	27	14
2.6	3.8	25	34	18	6	7	10	0
3.8	4.3	26	42	4	2	22	4	0
4.3	5.1	13	17	6	8	24	32	0†
5.1	5.7	14	17	8	8	19	23	11†
5.7	6.7	17	17	3	10	25	24	4†
6.7	7.4	9	13	7	28	33	10	0†
7.4	8.1	9	35	14	12	16	14	0†
8.1	9.0	2	29	18	15	17	19	0†
Mean		13	22	12	11	19	19	4

NS 53 NE 23 | 5850 3670 | Bransfield Farm, Darvel | Block A

Surface level +138.6 m (+455 ft)
Water struck at +136.6 m
Shell, 250 mm diameter
March 1976

Overburden 0.3 m
Mineral 1.9 m
Waste 8.4 m
Bedrock <0.1 m

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Alluvium	'Clayey' sandy gravel Gravel: fine and coarse, with cobbles and boulders, mainly basalt and dolerite Sand: medium to coarse, mineral and rock fragments Fines: clay, brown	1.9	2.2
Boulder clay	Clay, mid-grey, compact, sandy with angular to well rounded clasts	2.8	5.0
Glacial lake deposit	Clay, grey-brown, laminated, silty with sub-angular to rounded, red sandstone and basalt clasts	5.6	10.6
Carboniferous (Calciferous Sandstone Measures)	Basalt, blue-grey	<0.1	10.6

GRADING

Mean for Deposit

	%	mm	%
		+ 64	6
Gravel	42	- 64 + 16	16
		- 16 + 4	20
		- 4 + 1	17
Sand	43	- 1 + ¼	17
		- ¼ + 1/16	9
Fines	15	- 1/16	15

Depth below surface (m) From	To	Bulk Samples Percentages Fines -1/16	Sand -¼+1/16	Sand -1+¼	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
0.3	1.3	13	11	22	19	21	14	0
1.3	2.2	17	8	11	15	18	19	12†
Mean		15	9	17	17	20	16	6

Surface level +205.9 m (+676 ft)
Water not struck
Shell 250 mm and 200 mm diameter
March 1976

Overburden 0.7 m
Mineral 4.9 m
Waste 1.3 m
Mineral 11.1 m
Waste 2.1 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Soil	0.7	0.7
Glacial sand and gravel	(a) Gravel, with rare silty bands Gravel: fine to coarse with cobbles and boulders, subrounded to well rounded, red sandstone, basalts and vein quartz Sand: fine to coarse, angular to rounded, rock fragments Fines: clay, mid-brown	4.9	5.6
Glacial lake deposit	Silt, pebbly, grey-brown, laminated, with fine sand band from 5.8 to 6.0 m	1.3	6.9
Glacial sand and gravel	(b) Sand, with thin silty bands Gravel: rare, coarse with cobbles, subrounded, green sandstone and basic igneous material Sand: fine to medium with coarse, orange-brown to grey-brown, quartz with coaly bands Fines: silt	8.1	15.0
	(c) Sandy gravel Gravel: fine to coarse, rounded to well rounded, of varied igneous material Sand: medium to coarse with fine, light brown to grey, rock and mineral fragments	3.0	18.0
Boulder clay	Clay, sandy, silty, reddish brown, pebbly	1.0	19.0
Glacial sand and gravel	'Clayey' pebbly sand Gravel: fine to coarse Sand: fine and medium with coarse, mid-brown, with coaly fragments Fines: silt and clay	0.9	19.9
Boulder clay	Basalt cobbles and boulders in boulder clay	0.2+	20.1
	Borehole abandoned due to rock obstruction		

Mean for Deposit (b&c)	%	mm	%		Depth below surface (m) From	To	Bulk Samples Percentages Fines -1/16	Sand -¼+1/16	Sand -1+¼	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
		+ 64	0	(a)	0.7	1.7	7	9	9	7	12	17	39
Gravel	12	- 64 + 16	4		1.7	2.7	9	10	16	9	15	17	24
		- 16 + 4	8		2.7	3.7	9	11	18	11	23	28	0
					3.7	4.7	10	12	15	9	17	18	19
		- 4 + 1	10		4.7	5.6	9	12	16	12	25	26	0
Sand	79	- 1 + ¼	30		Mean		9	11	15	9	18	21	17
		- ¼ + 1/16	39										
				(b)	6.9	8.2	33	64	3	trace	0	0	0
Fines	9	- 1/16	9		8.2	9.2	8	35	41	15	1	0	0
					9.2	10.2	29	62	4	3	1	1	0
(a to c)					10.2	11.2	2	47	44	6	1	0	0
					11.2	12.2	2	24	60	12	2	0	0
		+ 64	5		12.2	13.2	2	41	45	11	1	trace	0
Gravel	25	- 64 + 16	9		13.2	14.2	6	56	32	6	trace	0	0
		- 16 + 4	11		14.2	15.0	3	60	31	6	trace	0	0
					Mean		11	49	32	7	1	trace	0
		- 4 + 1	10										
Sand	66	- 1 + ¼	25	(c)	15.0	15.8	1	17	40	17	18	7	0
		- ¼ + 1/16	31		15.8	16.8	1	6	21	27	34	11	0
					16.8	17.7	1	8	22	17	29	23	0
Fines	9	- 1/16	9		17.7	18.0	13	45	23	7	5	7	0
					Mean		2	13	27	19	26	13	0
					19.0	19.9	14	32	31	12	7	4	0 ‡

‡ Non-mineral: not considered in calculation of mean grading

NS 53 NE 25 | 5894 3604 | Loanfoot Farm, Darvel | Block B

Surface level +210.2 m (+690 ft)
Water not struck
Shell 250 mm and 200 mm diameter
April 1976

Overburden 0.3 m
Mineral 24.0 m
Waste 0.2 m+

LOG

Geological Classification		Lithology	Thickness m	Depth m
		Soil	0.3	0.3
Glacial sand and gravel	(a)	'Clayey' gravel Gravel: coarse and fine with cobbles, subrounded to rounded, basalt and other igneous material with brown sandstone Sand: fine to coarse Fines: clay	7.0	7.3
	(b)	'Clayey' sandy gravel Gravel: coarse and fine with cobbles, rounded with some angular, basalt Sand: fine to coarse Fines: clay	5.0	12.3
	(c)	'Very clayey' pebbly sand Gravel: fine with coarse, igneous material and quartz Sand: fine with medium and coarse, medium brown Fines: clay	5.0	17.3
	(d)	'Clayey' gravel Gravel: coarse and fine with cobbles, rounded, basalts and other igneous material, rare schist Sand: fine to coarse, quartz Fines: clay	7.0	24.3
? Boulder clay		Boulder and cobble bed	0.2+	24.5
		Borehole abandoned due to rock obstruction		

GRADING

Mean for Deposit (a to d)	%	mm	%		Depth below surface (m) From	To	Bulk Samples Percentages: Fines -1/16	Sand -¼+1/16	Sand -1+¼	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
		+ 64	1	(a)	0.3	1.3	32	8	14	11	16	19	0
Gravel	35	- 64 + 16	17		1.3	2.3	12	10	15	10	17	36	0
		- 16 + 4	17		2.3	3.3	12	13	14	9	16	36	0
					3.3	4.3	16	13	21	14	18	18	0
		- 4 + 1	13		4.3	5.3	9	15	17	9	11	4	35
Sand	47	- 1 + ¼	17		5.3	6.3	14	13	16	12	25	20	0
		- ¼ + 1/16	17		6.3	7.3	12	10	20	16	26	16	0
					Mean		15	12	17	11	19	21	5
Fines	18	- 1/16	18										
				(b)	7.3	8.3	18	12	34	18	12	6	0
					8.3	9.3	11	13	22	22	15	17	0
					9.3	10.3	12	10	23	19	19	17	0
					10.3	11.3	12	7	16	16	23	26	0
					11.3	12.3	14	11	20	19	22	14	0
					Mean		14	10	23	19	18	16	0
				(c)	12.3	13.3	22	26	20	14	13	5	0
					13.3	14.3	23	43	11	12	9	2	0
					14.3	15.3	32	50	8	5	4	1	0
					15.3	16.3	35	57	5	2	1	0	0
					16.3	17.3	24	46	18	7	4	1	0
					Mean		27	44	13	8	6	2	0
				(d)	17.3	18.3	15	11	15	12	21	26	0
					18.3	19.3	11	9	12	14	22	32	0
					19.3	20.3	12	7	15	15	28	23	0
					20.3	21.3	11	8	19	15	24	23	0
					21.3	22.3	32	6	12	10	16	24	0
					22.3	23.3	15	9	15	17	25	19	0
					23.3	24.3	14	10	14	14	24	24	0
					Mean		16	8	15	14	23	24	0

NS 53 NE 26 5911 3786 Passford Farm, Darvel Block B

Surface level +159.3 m (+523 ft)
Water struck at +138.3 m
Shell 250 mm and 200 mm diameter
February 1976

Overburden 0.6 m
Mineral 24.2 m
Waste 0.2 m+

LOG

Geological Classification		Lithology	Thickness m	Depth m
		Soil, sandy clay	0.6	0.6
Glacial sand and gravel	(a)	'Clayey' pebbly sand Gravel: fine to coarse with cobbles, subrounded to rounded, basalt, quartz and sandstone with quartzite Sand: fine to medium with coarse, quartz with rock and coal fragments, yellow to orange-brown Fines: clay, red, laminated in parts	18.9	19.5
	(b)	Sandy gravel Gravel: fine with coarse, subrounded to subangular, quartz, basalt, felsite and sandstone Sand: fine to coarse, micaceous, with coal fragments Fines: silt	5.3	24.8
Boulder clay		Clay, silty, compact, dark grey with basalt clasts and coal fragments	0.2+	25.0

NS 53 NE 26 Cont'd

GRADING

Mean for Deposit (a&b)	%	mm	%		Depth below surface (m) From	To	Bulk Samples Percentages Fines -1/16	Sand -¼+1/16	Sand -1+¼	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
		+ 64	1	(a)	0.6	1.6	20	33	10	5	6	4	22
Gravel	17	- 64 + 16	6		1.6	2.6	28	41	13	7	8	3	0
		- 16 + 4	10		2.6	3.5	23	41	25	7	3	1	0
					3.5	4.4	15	58	23	3	1	0	0
		- 4 + 1	10		4.4	5.5	24	42	21	7	6	0	0
Sand	68	- 1 + ¼	24		5.5	6.4	19	40	29	9	3	trace	0
		- ¼ + 1/16	34		6.4	7.4	9	48	41	2	trace	0	0
					7.4	8.5	11	36	40	7	5	1	0
Fines	15	- 1/16	15		8.5	9.4	18	51	26	4	1	0	0
					9.4	10.4	7	64	26	2	1	0	0
					10.4	11.4	29	48	19	4	trace	0	0
					11.4	12.4	14	25	14	16	21	10	0
					12.4	13.4	16	20	23	12	17	12	0
					13.4	14.4	21	51	22	3	3	0	0
					14.4	15.4	18	34	21	9	11	7	0
					15.4	16.4	9	26	18	11	19	17	0
					16.4	17.4	16	15	20	16	22	11	0
					17.4	18.5	19	22	17	12	15	7	8
					18.5	19.5	14	23	19	12	17	15	0
					Mean		18	37	22	8	8	5	2
				(b)	19.5	20.4	7	26	41	12	12	2	0
					20.4	21.4	5	14	18	16	23	24	0†
					21.4	22.8	3	20	34	20	16	7	0†
					22.8	23.8	3	14	36	20	20	7	0†
					23.8	24.8	10	41	21	11	13	4	0†
					Mean		6	23	30	16	16	9	0

NS 53 NE 27 5981 3740 Allanton Farm, Darvel Block B

Surface level +150.7 m (+494 ft)
Ground water level +147.1 m
Shell 250 mm and 200 mm diameter
April 1976

Overburden 0.5 m
Mineral 24.5 m+

LOG

Geological Classification		Lithology	Thickness m	Depth m
		Soil	0.5	0.5
Alluvium	(a)	'Clayey' gravel Gravel: coarse with fine and cobbles, subrounded to well rounded with subangular, basalt, grey and dark red sandstone, with coal fragments Sand: fine to medium with coarse, brownish grey, with coal fragments Fines: silt	2.0	2.5
Glacial lake deposit	(b)	'Very clayey' sand Gravel: rare, fine and coarse, basalt and coal Sand: fine with medium and rare coarse, brownish grey, micaceous, with coal fragments Fines: silt, disseminated	7.1	9.6
Glacial sand and gravel	(c)	Sandy gravel Gravel: fine and coarse with cobbles and boulders, basalt and sandstone Sand: fine to medium with coarse, brownish grey, with coal fragments	7.0	16.6
	(d)	Sand Gravel: rare fine and coarse, black shale and coal Sand: fine with medium and rare coarse, brownish grey, with coal fragments	8.4+	25.0

GRADING

Mean for Deposit (c to d)	%	mm	%		Depth below surface (m) From	To	Bulk Samples Percentages Fines -1/16	Sand -¼+1/16	Sand -1+¼	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
		+ 64	1	(a)	0.5	1.5	13	17	16	7	11	13	23
Gravel	15	- 64 + 16	7		1.5	2.5	16	20	12	8	11	33	0
		- 16 + 4	7		Mean		14	18	14	8	11	23	12
		- 4 + 1	6	(b)	2.5	3.6	36	63	1	trace	0	0	0
Sand	79	- 1 + ¼	32		3.6	4.6	45	48	3	1	1	2	0†
		- ¼ + 1/16	41		4.6	5.6	39	60	1	trace	0	0	0†
					5.6	6.6	18	75	7	trace	0	0	0†
Fines	6	- 1/16	6		6.6	7.6	22	72	6	trace	0	0	0†
					7.6	8.6	18	61	20	1	0	0	0†
(a to d)					8.6	9.6	23	56	20	1	0	0	0†
					Mean		29	62	9	trace	trace	trace	0
		+ 64	1										
Gravel	12	- 64 + 16	6	(c)	9.6	10.6	11	37	24	8	9	11	0†
		- 16 + 4	5		10.6	12.6	6	21	25	13	15	20	0†
					12.6	13.6	5	14	23	22	23	13	0†
		- 4 + 1	5		13.6	14.6	3	23	18	13	19	13	11†
Sand	75	- 1 + ¼	24		14.6	15.6	7	32	14	8	14	25	0†
		- ¼ + 1/16	46		15.6	16.6	8	42	23	12	11	4	0†
					Mean		7	27	22	12	15	15	2
Fines	13	- 1/16	13										
				(d)	16.6	17.6	8	54	37	1	trace	0	0†
					17.6	18.6	9	64	27	trace	0	0	0†
					18.6	19.6	6	65	28	1	0	0	0†
					19.6	20.6	4	63	28	1	1	3	0†
					20.6	21.6	3	50	46	1	0	0	0†
					21.6	22.6	5	47	47	1	trace	0	0†
					22.6	23.6	4	49	46	1	trace	0	0†
					23.6	25.0	4	42	53	1	trace	0	0†
					Mean		5	53	40	1	trace	1	0

NS 53 NE 28 | 5917 3701 | Laigh Newton, Darvel | Block B

Surface level +185.2 m (+608 ft)
Water struck at +181.7 m
Shell 250 mm and 200 mm diameter
March 1976

Overburden 0.5 m
Mineral 1.1m
Waste 14.2 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Soil, sandy loam	0.5	0.5
Glacial sand and gravel	'Very clayey' sand Sand: fine with medium, yellow-brown, micaceous Fines: silt	1.1	1.6
Boulder clay	Clay, sandy, dark reddish brown, angular to subrounded pebbles and rare basalt cobbles	3.4	5.0
	Clay, dark grey-brown, compact, stiff, with granodiorite, basalt and green sandstone clasts	10.8+	15.8
	Borehole abandoned due to rock obstruction		

GRADING

Mean for Deposit				Depth below surface (m)		Bulk Samples Percentages						
	%	mm	%	From	To	Fines	Sand			Gravel		
						-1/16	-¼+1/16	-1+¼	-4+1	-16+4	-64+16	+64
		+ 64	0	0.5	1.6	32	47	16	3	2	0	0
Gravel	2	- 64 + 16	0									
		- 16 + 4	2									
		- 4 + 1	3									
Sand	66	- 1 + ¼	16									
		- ¼ + 1/16	47									
Fines	32	- 1/16	32									

Surface level +205.6 m (+675 ft)
Water struck at +186.4 m
Shell 250 mm and 200 mm diameter
March 1976

Overburden 0.3 m
Mineral 10.3 m
Waste 8.6 m
Mineral 5.8 m+

LOG

Geological Classification		Lithology	Thickness m	Depth m
		Soil, clay, brown, stony	0.3	0.3
Glacial sand and gravel	(a)	Pebbly sand Gravel: igneous and sedimentary rocks Sand: fine to medium with coarse, subrounded to subangular, rarely angular, quartz and igneous rock fragments Fines: silt and clay, orange-brown	7.0	7.3
	(b)	'Very clayey' sandy gravel Gravel: fine to coarse with rare cobbles, subrounded and sub-angular, igneous and sedimentary rocks Sand: fine to coarse, subangular with subrounded, quartz and igneous rock fragments Fines: silt and clay, grey-brown	3.3	10.6
Boulder clay		Clay, stiff, pebbly, grey	8.6	19.2
Glacial sand and gravel	(c)	Sandy gravel Gravel: fine, subangular to sub-rounded, basalt common Sand: fine to coarse, angular to subangular, quartz, igneous and other rock fragments	1.6	20.8
	(d)	Sand Sand: fine and medium with coarse, subrounded and subangular, quartz and igneous rock fragments with detrital coal	4.2+	25.0

GRADING

Mean for Deposit (a&b)	%	mm	%		Depth below surface (m) From	To	Bulk Samples Percentages: Fines -1/16	Sand -¼+1/16	Sand -1+¼	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
		+ 64	0	(a)	0.3	1.3	1	26	56	7	9	1	0
Gravel	16	- 64 + 16	8		1.3	2.3	3	37	52	4	4	0	0
		- 16 + 4	8		2.3	3.3	1	25	58	7	7	2	0
					3.3	4.3	1	27	54	2	3	13	0
		- 4 + 1	9		4.3	5.3	1	12	67	12	7	1	0
Sand	77	- 1 + ¼	44		5.3	6.3	4	14	64	10	8	0	0
		- ¼ + 1/16	24		6.3	7.3	1	11	59	17	7	5	0
					Mean		2	22	59	8	6	3	0
Fines	7	- 1/16	7										
				(b)	7.3	8.3	20	23	13	5	10	29	0
(c&d)					8.3	9.3	20	26	14	7	11	22	0
					9.3	10.6	22	33	15	7	11	12	0
		+ 64	0		Mean		21	28	14	6	11	20	0
Gravel	10	- 64 + 16	1										
		- 16 + 4	9	(c)	19.2	19.8	12	11	24	21	28	4	0†
					19.8	20.8	4	15	30	23	27	1	0†
		- 4 + 1	10		Mean		7	14	28	22	27	2	0
Sand	82	- 1 + ¼	34										
		- ¼ + 1/16	38	(d)	20.8	21.8	11	45	32	5	7	0	0†
					21.8	22.8	8	39	38	13	2	0	0†
Fines	8	- 1/16	8		22.8	23.8	11	64	24	1	0	0	0†
					23.8	25.0	7	41	49	2	1	0	0†
(a to d)					Mean		9	47	36	5	3	0	0
		+ 64	0										
Gravel	14	- 64 + 16	6										
		- 16 + 4	8										
		- 4 + 1	9										
Sand	78	- 1 + ¼	40										
		- ¼ + 1/16	29										
Fines	8	- 1/16	8										

NS 53 NE 30 | 5966 3617 | Parbeth, Darvel | Block B

Surface level +221.4 m (+726 ft)
Water not struck
Shell 250 mm diameter
December 1975

Waste 7.3 m
Bedrock 1.7 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Soil, sandy	0.3	0.3
Boulder clay	Clay, sandy, reddish brown, with clasts of basalt, sandstones, dolerite and rare mica schist	3.9	4.2
	Clay, very compact, grey, with angular and rounded clasts of granodiorite, various porphyritic igneous rocks, limestone and coal fragments	1.5	5.7
	Clay, compact, reddish brown becoming yellow-brown below 7.0 m, with clasts of igneous material	1.6	7.3
Lower Old Red Sandstone	Porphyry, weathered, soft, medium grained, feldspar, quartz and biotite	1.7+	9.0

Surface level +222.3 m (+729 ft)
Water not struck
Shell 250 mm and 200 mm diameter
April 1976

Overburden 1.3 m
Mineral 12.9 m
Waste 10.8 m+

LOG

Geological Classification		Lithology	Thickness m	Depth m
		Soil, clayey at base	1.3	1.3
Glacial sand and gravel	(a)	Sandy gravel Gravel: coarse and fine with rare cobbles, subrounded to rounded, basalt, sandstone and quartz Sand: coarse to fine, rock fragments and quartz Fines: clay	10.0	11.3
	(b)	'Very clayey' sandy gravel Gravel: coarse with fine, basalt and sandstone Sand: fine with medium and coarse, rock fragments and quartz Fines: mainly clay	2.9	14.2
Boulder clay		Clay, sandy, compact, dark brown (red-brown at depth) with angular to sub-rounded clasts, mainly of basalt with grey sandstone and quartz	10.8+	25.0

GRADING

Mean for Deposit (a&b)	%	mm	%	Depth below surface (m) From	To	Bulk Samples Percentages Fines -1/16	Sand -¼+1/16	Sand -1+¼	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
		+ 64	trace	(a) 1.3	2.3	16	19	21	9	10	19	6
Gravel	39	- 64 + 16	21	2.3	3.5	6	10	18	14	19	33	0
		- 16 + 4	18	3.5	4.5	8	14	24	20	20	14	0
				4.5	5.5	6	13	20	22	29	10	0
		- 4 + 1	13	5.5	6.6	6	16	26	17	20	15	0
Sand	49	- 1 + ¼	19	6.6	7.6	6	25	26	13	20	10	0
		- ¼ + 1/16	17	7.6	8.5	6	11	16	10	22	35	0
				8.5	9.4	8	7	17	17	24	27	0
Fines	12	- 1/16	12	9.4	10.4	8	12	15	12	22	31	0
				10.4	11.3	10	20	22	10	12	26	0
				Mean		8	15	20	14	20	22	1
				(b) 11.3	12.3	29	35	16	4	5	11	0
				12.3	13.3	28	27	13	6	9	17	0
				13.3	14.2	16	15	15	12	16	26	0
				Mean		24	26	15	7	10	18	0

Surface level +136.3 m (+447 ft)
Section dry
Sampling by hand
July 1976

Mineral 13.3 m
Waste 1.2 m
Mineral 1.2 m
Waste 0.6 m+

LOG

Geological Classification		Lithology	Thickness m	Depth m
Glacial sand and gravel	(a)	Sandy gravel Gravel: fine to coarse with cobbles, subrounded to well rounded, basalts, sandstones, quartz with greywacke Sand: medium to coarse with fine rock fragments and quartz with coaly fragments Fines: rare silt bands	8.0	8.0
Glacial lake deposit	(b)	'Clayey' sand with laminated silt band from 11.0-11.7 m, and frequent thin coaly bands Sand: fine with medium, quartz, yellow, Fines: silt	5.3	13.3
Boulder clay		Clay, stiff, red-brown with angular to subrounded clasts of quartzite, felsite and sandstone	1.2	14.5
Glacial lake deposit	(c)	'Clayey' sand Sand: fine, quartz, yellow, with coaly bands Fines: silt	1.2	15.7
		Silt, micaceous, grey, with rare fine sand lenses	0.6+	16.3

GRADING

Mean for Deposit

(a&b)	%	mm	%
		+ 64	2
Gravel	27	- 64 + 16	11
		- 16 + 4	14
		- 4 + 1	12
Sand	65	- 1 + ¼	19
		- ¼ + 1/16	34
Fines	8	- 1/16	8
(a to c)			
		+ 64	1
Gravel	24	- 64 + 16	10
		- 16 + 4	13
		- 4 + 1	11
Sand	67	- 1 + ¼	18
		- ¼ + 1/16	38
Fines	9	- 1/16	9

Bulk Samples Percentages

	Depth below surface (m) From	To	Fines -1/16	Sand -¼+1/16	Sand -1+¼	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
(a)	0	1.0	8	2	6	14	21	41	8
	1.0	2.0	13	22	38	18	8	1	0
	2.0	3.0	1	4	12	12	30	34	7
	3.0	4.0	8	8	22	31	26	5	0
	4.0	5.0	3	5	26	21	31	14	0
	5.0	6.0	2	2	10	18	32	28	8
	6.0	7.0	2	7	49	23	12	7	0
	7.0	8.0	1	28	38	11	16	6	0
	Mean		5	10	25	18	22	17	3
(b)	8.0	9.0	12	81	6	1	trace	0	0
	9.0	10.0	24	74	2	trace	trace	0	0
	10.0	11.0	10	79	10	1	trace	0	0
	11.0	11.7	Silt						
	11.7	12.3	7	76	17	trace	0	0	0
	12.3	13.3	9	74	17	trace	0	0	0
	Mean		13	77	10	trace	trace	0	0
(c)	14.5	15.7	19	79	2	0	0	0	0

NS 53 SW 64 5398 3399 Cairnhill Farm, Newmilns Block F_3

Surface level +242.6 m (+796 ft)
Water not struck
Shell 250 mm and 200 mm diameter
April 1976

Waste 9.3 m
Bedrock 1.3 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Peat	Peat	0.3	0.3
Boulder clay	Clay, stiff, mottled, brown with frequent cobbles of basalt and sandstone	9.0	9.3
Upper Old Red Sandstone	Sandstone, weathered at top, becoming hard, greenish grey at depth	1.3+	10.6

NS 54 SE 2 5673 4059 Gateside Farm, Darvel Block F_1

Surface level +203.9 m (+669 ft)
Ground water level +200.3 m
Shell 250 mm diameter
March 1976

Overburden 0.7 m
Mineral 3.9 m
Waste 3.3 m
Bedrock 0.1 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Soil	0.7	0.7
Glacial sand and gravel	'Clayey' gravel Gravel: fine and coarse with well rounded cobbles, mainly igneous material Sand: fine to coarse, clayey Fines: clay	3.9	4.6
Boulder clay	Clay, sandy, compact, dark grey-brown, with clasts of varied composition	3.3	7.9
Carboniferous (Calciferous Sandstone Measures)	Basalt, blue-grey with rare zeolites	0.1+	8.0

GRADING

Mean for Deposit					Depth below surface (m)		Bulk Samples Percentages						
	%	mm	%		From	To	Fines -1/16	Sand -$\frac{1}{4}$+1/16	Sand -1+$\frac{1}{4}$	Sand -4+1	Gravel -16+4	Gravel +64-16	Gravel +64
		+ 64	0		0.7	1.7	13	10	13	11	19	34	0
Gravel	53	- 64 + 16	32		1.7	2.7	13	13	11	10	17	36	0
		- 16 + 4	21		2.7	3.7	13	11	12	11	19	34	0
					3.7	4.6	10	11	14	12	29	24	0
		- 4 + 1	11		Mean		12	11	13	11	21	32	0
Sand	35	- 1 + $\frac{1}{4}$	13										
		- $\frac{1}{4}$ + 1/16	11										
Fines	12	- 1/16	12										

NS 54 SE 3 5766 4002 Feoch Farm, Darvel Block F_1

Surface level +203.1 m (+666 ft)
Water not struck
Shell 250 mm and 200 mm diameter
March 1976

Waste 16.6 m
Bedrock 0.4 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Soil, sandy loam	0.4	0.4
Boulder clay	Clay, sandy, greyish brown, compact, stony, weathered to 1.7 m	15.0	15.4
	Clay, grey-black, with abundant clasts of black shale, mudstone and impure sandy limestone	1.2	16.6
Carboniferous (Limestone Coal Group)	Seat-earth, weathered, fine grained, cream	0.4+	17.0

NS 63 NW 57 6037 3792 Newlands Farm, Loudoun Hill Block B

Surface level +208.7 m (+685 ft)
Water struck at +205.5 m
Shell 250 mm diameter
February 1976

Waste 8.8 m
Bedrock <0.1 m

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Soil, brown, clayey	0.3	0.3
Boulder clay	Clay, sandy, brown, stiff, with clasts of basalt and sandstone	2.9	3.2
Glacial lake deposit	Silt, sandy, brown becoming grey at depth, laminated with 'very clayey' fine sand, micaceous from 5.0 to 6.5 m	4.1	7.3
Boulder clay	Clay, red-brown, stiff, with sandy bands and clasts of basalt and sandstone	1.5	8.8
Carboniferous (Calciferous Sandstone Measures)	Basalt, grey, amygdaloidal, iron-stained	<0.1	8.8

GRADING

Depth below surface (m) From	To	Bulk Samples Percentages Fines -1/16	Sand $-\frac{1}{4}+1/16$	$-1+\frac{1}{4}$	-4+1	Gravel -16+4	-64+16	+64
5.0	6.5	17	70	13	trace	0	0	0†‡

‡Non-mineral: not considered in calculation of mean grading

NS 63 NW 58 6018 3680 Allanton Farm, Loudoun Hill Block B

Surface level +215.3 m (+706 ft)
Water not struck
Shell 250 mm and 200 mm diameter
December 1975

Overburden 0.7 m
Mineral 4.9 m
Waste 6.1 m+

LOG

Geological Classification		Lithology	Thickness m	Depth m
		Soil	0.7	0.7
Glacial sand and gravel	(a)	'Clayey' pebbly sand with band of boulder clay from 1.3 to 2.0 m Gravel: fine to coarse with cobbles, angular to well rounded, basalt, granodiorite, pink quartzite, sandstone and quartz Sand: fine to medium with coarse, mid-brown Fines: silt and clay	3.1	3.8
	(b)	Gravel Gravel: fine to coarse, well rounded, igneous material, sandstone and quartz Sand: medium to coarse with fine, mid-brown, mineral and rock fragments	1.8	5.6
Boulder clay		Clay, sandy, reddish brown, compact with angular clasts of igneous material, sandstone, vein quartz, pink granite and rare schist	6.1+	11.7

Borehole abandoned due to rock obstruction

GRADING

Mean for Deposit (a&b)					Depth below surface (m)		Bulk Samples Percentages						
	%	mm	%		From	To	Fines -1/16	Sand -¼+1/16	Sand -1+¼	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
		+ 64	3	(a)	0.7	1.3	6	37	31	7	9	10	0
Gravel	29	- 64 + 16	13		1.3	2.0	39	23	13	4	6	15	0
		- 16 + 4	13		2.0	3.0	15	52	24	3	4	2	0
					3.0	3.8	11	36	25	8	10	10	0
		- 4 + 1	9		Mean		18	38	23	5	7	9	0
Sand	58	- 1 + ¼	21										
		- ¼ + 1/16	28	(b)	3.8	4.8	7	11	21	16	15	14	16
					4.8	5.6	5	8	14	15	31	27	0
Fines	13	- 1/16	13		Mean		6	9	18	16	22	20	9
					6.6	7.6	16	22	6	8	16	32	0 ‡

‡ Non-mineral not considered in calculation of mean grading

NS 63 NW 59 6049 3598 Burnhead Farm, Loudoun Hill Block B

Surface level +233.4 m (+766 ft)
Water struck at +230.9 m
Shell 250 mm diameter
December 1976

Waste 3.6 m
Bedrock 0.4 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Soil, sandy, pebbly	0.6	0.6
Boulder clay	Clay, sandy, weathered at top, grey-brown, with numerous angular clasts of diorite	3.0	3.6
Lower Old Red Sandstone Intrusion	Abundant diorite fragments	0.4+	4.0

NS 63 NW 60 6160 3815 Roughdiamond Farm, Loudoun Hill Block F_1

Surface level +238.2 m (+781 ft)
Water not struck
Shell 250 mm diameter
January 1976

Waste 5.1 m
Bedrock 0.3 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Boulder clay	Clay, sandy in parts, hard, mottled, brown to brownish grey, with roots and clasts of weathered basalt and sandstone	4.9	5.1
Carboniferous (Calciferous Sandstone Measures)	Basalt, amygdaloidal, black	0.3+	5.4

NS 63 NW 61 6120 3768 Allantonplains, Loudoun Hill Block C

Surface level +222.4 m (+730 ft)
Water struck at +204.7 m
Shell 250 mm and 200 mm diameter
December 1975

Overburden 0.6 m
Mineral 18.1 m
Waste 3.4 m+

LOG

Geological Classification		Lithology	Thickness m	Depth m
		Soil, with weathered, clayey coarse gravel	0.6	0.6
Glacial sand and gravel	(a)	Gravel Gravel: fine to coarse with cobbles, subangular to well rounded, sandstone, basalt, quartz and quartzite Sand: medium to coarse with fine, rock fragments and quartz	5.0	5.6
	(b)	Sandy gravel Gravel: fine to coarse with rare cobbles, subrounded to well rounded, basalt and quartz Sand: fine to medium with coarse, quartz	4.7	10.3
	(c)	Sand Gravel: rare, subangular to well rounded, basalt and quartz Sand: fine with medium, quartz with feldspar and rock fragments, and coaly fragments Fines: silt	6.4	16.7
Glacial lake deposit	(d)	'Very clayey' sand Sand: fine, mid-brown Fines: silt	2.0	18.7
		Silt, laminated, mid-brown, with bands of chocolate-brown clay and laminae of very fine sand	3.3	22.0
Boulder clay		Clay, sandy, with numerous angular to subangular clasts of igneous material, sandstones and quartz	0.1+	22.1
		Borehole abandoned due to rock obstruction		

GRADING

Mean for Deposit

(a to c)	%	mm	%
		+ 64	3
Gravel	25	- 64 + 16	11
		- 16 + 4	11
		- 4 + 1	8
Sand	69	- 1 + $\frac{1}{4}$	28
		- $\frac{1}{4}$ + 1/16	33
Fines	6	- 1/16	6
(a to d)			
		+ 64	3
Gravel	23	- 64 + 16	10
		- 16 + 4	10
		- 4 + 1	7
Sand	69	- 1 + $\frac{1}{4}$	25
		- $\frac{1}{4}$ + 1/16	37
Fines	8	- 1/16	8

	Depth below surface (m) From	To	Bulk Samples Percentages: Fines -1/16	Sand -$\frac{1}{4}$+1/16	Sand -1+$\frac{1}{4}$	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
(a)	0.6	1.6	8	12	21	14	19	22	4
	1.6	2.6	7	10	19	14	15	20	15
	2.6	3.6	8	10	19	13	20	20	10
	3.6	4.6	8	8	17	13	18	32	4
	4.6	5.6	7	6	13	14	17	31	12
	Mean		7	9	18	14	18	25	9
(b)	5.6	6.8	7	16	31	14	16	16	0
	6.8	7.8	5	16	28	11	22	18	0
	7.8	9.3	3	21	37	14	17	8	0
	9.3	10.3	4	32	37	10	11	6	0
	Mean		5	21	33	12	17	12	0
(c)	10.3	11.3	4	52	38	1	2	3	0
	11.3	12.3	13	64	19	1	1	2	0
	12.3	13.3	7	63	30	trace	0	0	0
	13.3	14.3	4	63	33	trace	0	0	0
	14.3	15.3	5	63	32	trace	0	0	0
	15.3	16.7	4	58	37	1	trace	0	0
	Mean		6	60	32	1	trace	1	0
(d)	16.7	17.7	21	71	8	trace	0	0	0
	17.7	18.7	30	68	2	trace	0	0	0†
	Mean		26	70	4	trace	0	0	0

NS 63 NW 62 | 6163 3672 | Allantonplains, Loudoun Hill | Block C

Surface level +201.8 m (+662 ft)
Ground water level +196.8 m
Shell 250 mm and 200 mm diameter
March 1976

Overburden 4.6 m
Mineral 3.0 m
Waste 4.0 m
Mineral 4.0 m
Waste 9.5 m+

LOG

Geological Classification		Lithology	Thickness m	Depth m
		Ballast	1.6	1.6
Peat		Peat	2.0	3.6
Boulder clay		Clay, sandy, pebbly	1.0	4.6
Glacial sand and gravel	(a)	'Clayey' sandy gravel Gravel: fine to coarse with cobbles, subrounded to angular, dominantly igneous material Sand: fine to coarse, angular to sub-rounded, quartz and igneous rock fragments Fines: silt and clay, grey	3.0	7.6
Glacial lake deposit		Silt, sandy, clayey, grey	4.0	11.6
	(b)	'Very clayey' sand with rare silt bands Sand: fine, silty, grey-brown, micaceous, with coal fragments	4.0	15.6
		Silt, grey brown, with fine sand bands and chocolate-brown clay bands, increasing at depth; coal fragments more abundant at depth	9.5+	25.1

GRADING

Mean for Deposit

(a&b)	%	mm	%
		+ 64	0
Gravel	14	- 64 + 16	10
		- 16 + 4	4
		- 4 + 1	3
Sand	60	- 1 + $\frac{1}{4}$	6
		- $\frac{1}{4}$ + 1/16	51
Fines	26	- 1/16	26

Bulk Samples Percentages

	Depth below surface (m) From	To	Fines -1/16	Sand -$\frac{1}{4}$+1/16	Sand -1+$\frac{1}{4}$	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
(a)	4.6	5.6	9	12	18	10	8	43	0
	5.6	6.6	10	39	13	7	16	15	0
	6.6	7.6	22	50	10	3	3	12	0†
	Mean		14	33	14	7	9	23	0
(b)	11.6	12.6	27	71	1	1	0	0	0†
	12.6	13.6	40	59	1	trace	0	0	0†
	13.6	14.6	37	62	1	trace	0	0	0†
	14.6	15.6	37	63	trace	0	0	0	0†
	Mean		35	64	1	trace	0	0	0

NS 63 NW 63 6152 3653 White Hill, by Loudoun Hill Block C

Surface level +213.4 m (+700 ft)
Water not struck
Shell 250 mm diameter
December 1975

Overburden 1.0 m
Mineral 3.8 m
Waste 1.7 m+

LOG

Geological Classification		Lithology	Thickness m	Depth m
		Soil	1.0	1.0
Glacial sand and gravel	(a)	Gravel Gravel: fine to medium, rounded to well rounded, sandstone and igneous material Sand: coarse to fine, dark brown Fines: clay	1.6	2.6
Glacial lake deposit	(b)	'Very clayey' sand, with frequent thinly laminated silt bands Sand: fine with medium, grey to reddish brown, quartz Fines: silt	2.2	4.8
Boulder clay		Clay, sandy, numerous cobbles, compact with predominantly igneous clasts, including granodiorite	1.7+	6.5

Borehole abandoned due to rock obstruction

GRADING

Mean for Deposit

	%	mm	%
		+ 64	0
Gravel	22	- 64 + 16	9
		- 16 + 4	13
		- 4 + 1	8
Sand	64	- 1 + $\frac{1}{4}$	12
		- $\frac{1}{4}$ + 1/16	44
Fines	14	- 1/16	14

(a&b)	Depth below surface (m) From	To	Bulk Samples Percentages Fines -1/16	Sand -$\frac{1}{4}$+1/16	Sand -1+$\frac{1}{4}$	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
(a)	1.0	2.0	5	9	12	19	30	25	0
	2.0	2.6	6	18	20	14	28	14	0
	Mean		6	12	15	17	29	21	0
(b)	2.6	3.6	9	75	14	1	1	0	0
	3.6	4.8	29	60	7	3	1	0	0
	Mean		20	67	10	2	1	0	0

NS 63 NW 64 | 6178 3573 | Waterhead Farm, Avondale | Block C

Surface level +219.7 m (+721 ft)
Water struck at +217.5 m
Shell 250 mm and 200 mm diameter
December 1975

Overburden 1.1 m
Mineral 2.1 m
Waste 11.9 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Soil	0.7	0.7
Boulder clay	Clay, sandy, compact, grey-brown with subangular to rounded clasts of varied composition	0.4	1.1
Glacial sand and gravel	'Clayey' gravel Gravel: fine to coarse, well rounded Sand: fine to coarse	2.1	3.2
Boulder clay	Clay, grey-brown with subangular to subrounded clasts	11.9+	15.1
	Borehole abandoned due to rock obstruction		

GRADING

Mean for Deposit				Depth below surface (m)		Bulk Samples Percentages						
	%	mm	%	From	To	Fines	Sand			Gravel		
						-1/16	-¼+1/16	-1+¼	-4+1	-16+4	-64+16	+64
		+ 64	0	1.1	2.1	10	9	19	18	24	20	0
Gravel	48	- 64 + 16	21	2.1	3.2	10	9	13	16	30	22	0†
		- 16 + 4	27	Mean		10	9	16	17	27	21	0
		- 4 + 1	17									
Sand	42	- 1 + ¼	16									
		- ¼ + 1/16	9									
Fines	10	- 1/16	10									

NS 63 NW 65 | 6249 3711 | Lochgate Farm, Avondale | Block C

Surface level +198.6 m (+652 ft)
Ground water level +196.5 m
Shell 250 mm and 200 mm diameter
January 1976

Overburden 2.0 m
Mineral 4.6 m
Waste 13.4 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Peat	Ballast on peaty soil	2.0	2.0
Glacial sand and gravel	Gravel Gravel: coarse and fine, rounded to subangular, igneous rocks, quartz and some sandstone Sand: fine to coarse, frequently angular, rock fragments and quartz	4.6	6.6
Glacial lake deposit	Silt, grey, with laminated chocolate-brown clay with coaly fragments at top	10.7	17.3
Glacial sand and gravel	Sandy gravel Gravel: fine and coarse, well rounded and angular, sandstone and basalt Sand: fine to coarse, rock fragments and quartz	2.0	19.3
	Boulders of dolerite and amygdaloidal basalt	0.7+	20.0

Borehole abandoned due to rock obstruction

GRADING

Mean for Deposit

	%	mm	%
		+ 64	0
Gravel	63	- 64 + 16	35
		- 16 + 4	28
		- 4 + 1	16
Sand	33	- 1 + ¼	10
		- ¼ + 1/16	7
Fines	4	- 1/16	4

Bulk Samples Percentages

Depth below surface (m) From	To	Fines -1/16	Sand -¼+1/16	Sand -1+¼	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
2.0	3.0	3	1	3	10	33	50	0†
3.0	4.0	3	18	9	2	25	43	0†
4.0	5.6	3	3	12	21	28	33	0†
5.6	6.6	9	7	16	28	28	12	0†
Mean		4	7	10	16	28	35	0
17.3	18.5	11	11	13	25	23	17	0†‡
18.5	19.3	6	16	19	16	19	24	0†‡

‡ Non-mineral: not considered in calculation of mean grading

NS 63 NW 66 | 6249 3628 | Sheiloans, Avondale | Block C

Surface level +213.8 m (701 ft)
Ground water level +211.7 m
Shell 250 mm diameter
December 1975

Overburden 0.5 m
Mineral 3.9 m
Waste 7.6 m
Bedrock 0.2 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Soil	0.5	0.5
Glacial sand and gravel	'Very clayey' pebbly sand Gravel: fine and coarse with cobbles, subrounded to well rounded, granite, dolerite and sandstone Sand: fine to coarse with bands of pink granite fragments Fines: silt	3.9	4.4
Boulder clay	Clay, sandy, dark reddish brown becoming dark grey at depth with subangular to rounded sandstone and basalt clasts	7.6	12.0
Lower Old Red Sandstone	Sandstone, medium grained, greenish red, arkosic, micaceous	0.2+	12.2

GRADING

Mean for Deposit

%	mm	%
	+ 64	0
Gravel 20	- 64 + 16	11
	- 16 + 4	9
	- 4 + 1	15
Sand 60	- 1 + $\frac{1}{4}$	18
	- $\frac{1}{4}$ + 1/16	27
Fines 20	- 1/16	20

Bulk Samples Percentages

Depth below surface (m) From	To	Fines -1/16	Sand -$\frac{1}{4}$+1/16	Sand -1+$\frac{1}{4}$	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
0.5	1.5	14	15	12	8	16	35	0
1.5	2.5	20	34	18	8	12	8	0
2.5	3.5	26	40	20	5	6	3	0
3.5	4.4	25	4	25	43	2	1	0 †
Mean		20	27	18	15	9	11	0

Surface level +212.1 m (+696 ft)
Ground water level +209.8 m
Shell 250 mm diameter
January 1976

Waste 2.8 m
Bedrock 2.2 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Soil, peaty	0.4	0.4
Boulder clay	Clay, hard at depth, yellowish, with roots and clasts of basalt and sandstone	2.4	2.8
Carboniferous (Calciferous Sandstone Measures)	Sandstone, brownish grey, micaceous, weathered at top, with plant fragments	2.2+	5.0

Surface level +197.8 m (+649 ft)
Ground water level +194.0 m
Shell 250 mm and 200 mm diameter
January 1976

Overburden 0.5 m
Mineral 2.7 m
Waste 5.3 m
Mineral 11.0 m+

LOG

Geological Classification		Lithology	Thickness m	Depth m
Peat		Peat	0.5	0.5
Alluvium	(a)	Gravel Gravel: coarse and fine with cobbles, angular, basalt, sandstone and felsite Sand: coarse, rock fragments	2.7	3.2
Glacial lake deposit		Clay, dark grey, stiff, laminated, with rare pebbles	1.0	4.2
Boulder clay		Clay, sandy, chocolate-brown, with clasts of basalt, sandstone and quartz	4.3	8.5
Glacial sand and gravel	(b)	Sandy gravel Gravel: coarse and fine with cobbles, subangular to rounded, basalt, grey sandstone and quartz Sand: mainly fine with medium and coarse, quartz and rock fragments	4.5	13.0
	(c)	Sand Sand: fine with medium, quartz and mica with coaly fragments Fines: mainly silt	5.2	18.2
	(d)	'Very clayey' sand Sand: fine with medium, quartz and mica Fines: silt, dark grey, stiff and finely laminated in parts, micaceous	1.3+	19.5
		Borehole abandoned due to rising sand		

GRADING

Mean for Deposit (b to d)	%	mm	%		Depth below surface (m) From	To	Fines -1/16	Bulk Samples Percentages Sand -¼+1/16	Sand -1+¼	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
		+ 64	7	(a)	0.5	1.5	4	5	12	14	21	27	17
Gravel	19	- 64 + 16	7		1.5	3.2	6	5	9	13	20	35	12†
		- 16 + 4	5			Mean	5	5	10	14	20	32	14
		- 4 + 1	4	(b)	8.5	**9.5**	3	13	20	12	18	31	3†
Sand	73	- 1 + ¼	29		**9.5**	**10.5**	**2**	10	17	12	21	29	9†
		- ¼ + 1/16	40		10.5	11.5	**5**	40	18	5	8	14	10†
					11.5	13.0	6	55	8	trace	trace	trace	31†
Fines	8	- 1/16	8			Mean	4	32	15	6	11	17	15
(a to d)				(c)	13.0	14.0	10	74	13	1	trace	2	0†
		+ 64	8		14.0	15.0	9	71	19	trace	trace	1	0†
Gravel	28	- 64 + 16	12		15.0	16.0	10	46	43	1	trace	trace	0†
		- 16 + 4	8		16.0	17.3	9	20	64	5	1	1	0†
					17.3	18.2	4	15	62	6	1	0	12†
		- 4 + 1	6			Mean	8	44	42	3	trace	1	2
Sand	64	- 1 + ¼	25										
		- ¼ + 1/16	33	(d)	18.2	18.6	23	23	46	4	1	3	0†
					18.6	19.5	23	58	18	1	trace	0	0†
Fines	8	- 1/16	8			Mean	23	48	26	2	trace	1	0

NS 63 NW 69 | 6396 3695 | Peelhill Farm, Avondale | Block C

Surface level +212.4 m (+697 ft)
Water not struck
Shell 250 mm and 200 mm diameter
March 1976

Overburden 0.3 m
Mineral 2.2 m
Waste 14.7 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Peaty soil	0.3	0.3
Glacial sand and gravel	'Clayey' sandy gravel Gravel: coarse with fine and cobbles, angular to well rounded, basalt, dolerite, and quartzite Sand: fine to medium with coarse, subrounded with subangular, quartz and rock fragments, brown Fines: clay	2.2	2.5
Boulder clay	Clay, stiff, brown, with fine and coarse clasts, 'clayey' pebbly sand from 14.5 to 17.2 m	14.7+	17.2

Borehole abandoned due to rock obstruction

GRADING

Mean for Deposit

	%	mm	%
		+ 64	0
Gravel	31	- 64 + 16	22
		- 16 + 4	9
		- 4 + 1	8
Sand	58	- 1 + ¼	18
		- ¼ + 1/16	32
Fines	11	- 1/16	11

Bulk Samples Percentages

Depth below surface (m) From	To	Fines -1/16	Sand -¼+1/16	Sand -1+¼	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
0.3	1.3	10	29	21	10	12	18	0
1.3	2.3	13	33	17	6	6	25	0
2.3	2.5	12	33	12	5	10	28	0
Mean		11	32	18	8	9	22	0
14.5	15.5	35	34	18	6	6	1	0 ‡
15.5	16.5	12	27	36	11	8	6	0 ‡
16.5	17.2	7	28	30	14	9	12	0 ‡

‡ Non-mineral: not considered in calculation of mean grading

NS 63 NW 70 | 6354 3659 | Overhouses Farm, Avondale | Block C

Surface level +204.7 m (+672 ft)
Ground water level +198.7 m
Shell 250 mm diameter
November 1975

Overburden 2.5 m
Mineral 12.9 m+

LOG

Geological Classification		Lithology	Thickness m	Depth m
Peat on alluvium		Peat, silty below 1.3 m	2.5	2.5
Glacial sand and gravel	(a)	'Clayey' sandy gravel Gravel: coarse and fine, angular to subrounded, grey and red sandstone, altered basalt with quartz Sand: mainly medium with coarse and fine, rock fragments and quartz Fines: clay	3.1	5.6
	(b)	Sandy gravel Gravel: coarse and fine with cobbles, angular to subrounded, sandstone, basalt, felsite, quartzite and quartz with rare granite Sand: fine to coarse, rock fragments and quartz, silty in parts with coal fragments	9.8+	15.4

Borehole abandoned due to rising sand

GRADING

Mean for Deposit (a&b)	%	mm	%		Depth below surface (m) From	To	Bulk Samples Percentages: Fines -1/16	Sand -¼+1/16	Sand -1+¼	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
		+ 64	4	(a)	2.5	3.5	11	24	33	12	14	6	0
Gravel	36	- 64 + 16	14		3.5	4.6	18	16	31	13	12	10	0
		- 16 + 4	18		4.6	5.6	16	12	25	13	17	17	0†
					Mean		15	17	30	12	15	11	0
		- 4 + 1	18										
Sand	58	- 1 + ¼	25	(b)	5.6	6.2	6	13	36	18	12	15	0†
		- ¼ + 1/16	15		6.2	7.7	4	5	14	14	22	32	9†
					7.7	8.6	2	7	16	11	17	34	13†
Fines	6	- 1/16	6		8.6	9.6	4	16	37	17	12	10	4†
					9.6	10.6	2	21	35	19	16	7	0†
					10.6	11.6	9	28	33	16	8	6	0†
					11.6	11.8	14	25	19	22	17	3	0†
					11.8	13.4	3	8	17	32	36	4	0†
					13.4	14.4	1	16	27	25	15	8	8†
					14.4	15.4	3	14	16	17	17	16	17†
					Mean		4	13	24	19	19	15	6

NS 63 NW 71 6387 3615 Overhouses, Avondale Block C

Surface level +219.2 m (+719 ft)
Water not struck
Shell 250 mm diameter
January 1976

Waste 2.1 m
Bedrock 1.3 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Peat	Peat, silty	1.2	1.2
?Boulder clay	Silt, dark grey-blue, micaceous with sandy bands and rare pebbles	0.9	2.1
Lower Old Red Sandstone	Sandstone, flaggy, light purplish green, micaceous	1.3+	3.4

Surface level +196.4 m (+644 ft)
Ground water level +186.4 m
Shell 300 mm, 250 mm and 200 mm diameter
November 1975

Overburden 0.5 m
Mineral 16.5 m
Waste 8.5 m+

LOG

Geological Classification		Lithology	Thickness m	Depth m
		Soil	0.5	0.5
Glacial sand and gravel	(a)	Pebbly sand, gravelly at top Gravel: fine to medium with coarse, rounded to well rounded, fine grained igneous material, quartz and sandstone Sand: medium to fine with coarse, reddish brown, angular to rounded, quartz with feldspar and rock fragments	5.6	6.1
Glacial lake deposit	(b)	'Very clayey' sand with frequent silty bands Sand: fine with medium, reddish brown, mainly rounded with some angular, quartz with feldspar and coal fragments Fines: clay, becoming silty at depth	10.9	17.0
		Silt, grey becoming chocolate-brown at depth, compact, laminated with rare fine sand bands	4.0	21.0
Boulder clay		Clay, sandy, compact, hard, brown, with rounded to well rounded clasts of predominantly igneous material	4.5+	25.5

GRADING

Mean for Deposit

(a&b)	%	mm	%
		+ 64	0
Gravel	4	- 64 + 16	1
		- 16 + 4	3
		- 4 + 1	3
Sand	80	- 1 + ¼	22
		- ¼ + 1/16	55
Fines	16	- 1/16	16

	Depth below surface (m) From	To	Fines -1/16	Sand -¼+1/16	Sand -1+¼	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
	Bulk Samples Percentages								
(a)	0.5	1.7	6	12	33	17	24	8	0
	1.7	3.1	4	30	49	6	7	4	0
	3.1	4.1	5	27	55	6	6	1	0
	4.1	5.1	6	23	58	7	5	1	0
	5.1	6.1	8	46	42	1	1	2	0
	Mean		6	27	47	8	9	3	0
(b)	6.1	7.1	14	72	14	trace	0	0	0
	7.1	8.1	12	75	13	trace	0	0	0
	8.1	9.3	15	76	9	trace	0	0	0
	9.3	10.3	24	71	5	trace	0	0	0†
	10.3	11.3	26	68	6	trace	trace	0	0†
	11.3	12.3	26	71	3	trace	0	0	0†
	12.3	13.8	23	64	10	2	1	0	0†
	13.8	15.0	24	65	8	1	1	1	0†
	15.0	16.0	18	66	16	trace	0	0	0†
	16.0	17.0	27	64	9	trace	0	0	0†
	Mean		21	69	9	1	trace	trace	0

NS 63 NW 73 | 6459 3900 | Snabe Pit, Drumclog | Block D

Surface level +185.3 m (+608 ft)
Water struck at +184.8 m (Artesian)
Shell 250 mm diameter
January 1976

Mineral 9.5 m+

LOG

Geological Classification		Lithology	Thickness m	Depth m
Glacial sand and gravel	(a)	Pebbly sand Gravel: fine and coarse, well rounded, basalt, sandstone and quartz Sand: fine with medium, rounded quartz and rock fragments with coaly particles Fines: silt	7.0	7.0
	(b)	Sandy gravel Gravel: fine and coarse, well rounded, basalt with granite and sandstone Sand: fine to coarse	2.5+	9.5
		Borehole abandoned due to rising sand		

GRADING

Mean for Deposit (a&b)	%	mm	%		Depth below surface (m) From	To	Bulk Samples Percentages: Fines -1/16	Sand -¼+1/16	Sand -1+¼	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
		+ 64	0	(a)	0	1.0	9	41	34	7	6	3	0†
Gravel	14	- 64 + 16	8		1.0	4.0	7	58	34	1	trace	trace	0†
		- 16 + 4	6		4.0	7.0	6	59	23	3	2	7	0†
					Mean		7	56	29	2	2	4	0
		- 4 + 1	6										
Sand	80	- 1 + ¼	28	(b)	7.0	8.0	7	40	26	9	8	10	0†
		- ¼ + 1/16	46		8.0	9.5	1	4	26	18	20	31	0†
					Mean		4	18	26	14	15	23	0
Fines	6	- 1/16	6										

NS 63 NW 74 6425 3825 North Torfoot Farm, Drumclog Block C

Surface level +187.8 m (+616 ft)
Ground water level +185.6 m
Shell 250 mm and 200 mm diameter
January 1976

Overburden 0.2 m
Mineral 11.0 m
Waste 10.8 m+

LOG

Geological Classification		Lithology	Thickness m	Depth m
		Soil	0.2	0.2
Alluvium	(a)	Sandy gravel Gravel: fine and coarse, well rounded, basalt, quartzite, quartz, sandstone and granite Sand: coarse to fine, well rounded, quartz and rock fragments	5.0	5.2
Glacial lake deposit	(b)	'Clayey' sand Sand: fine, quartz and rock fragments, micaceous with coaly fragments Fines: silt	6.0	11.2
		Silt, brown and reddish brown, laminated, micaceous, sandy in parts with rare pebbles below 13.2 m	10.8+	22.0
		Borehole abandoned due to rising sand		

GRADING

Mean for Deposit (a&b)					Depth below surface (m)		Bulk Samples Percentages						
	%	mm	%		From	To	Fines	Sand			Gravel		
							-1/16	-¼+1/16	-1+¼	-4+1	-16+4	-64+16	+64
		+ 64	0	(a)	0.2	1.2	5	8	13	15	27	32	0
Gravel	21	- 64 + 16	11		1.2	2.2	7	8	13	13	25	34	0
		- 16 + 4	10		2.2	3.2	3	10	22	17	18	30	0†
					3.2	4.2	12	16	11	14	27	20	0†
		- 4 + 1	7		4.2	5.2	10	44	23	12	10	1	0†
Sand	69	- 1 + ¼	10		Mean		7	17	17	14	22	23	0
		- ¼ + 1/16	52										
				(b)	5.2	7.2	12	80	6	2	0	0	0 †
Fines	10	- 1/16	10		7.2	9.2	11	83	6	trace	trace	0	0 †
					9.2	11.2	13	81	4	1	1	0	0 †
					Mean		11	82	6	1	trace	0	0

NS 63 NW 75 6487 3748 North Halls Farm, Avondale Block C

Surface level +207.8 m (+682 ft)
Water struck at +206.0 m
Shell 250 mm diameter
January 1976

Overburden 0.3 m
Mineral 2.4 m
Waste 5.3 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Glacial sand and gravel	Sand Sand: fine to medium, subrounded with some angular and well rounded, quartz with feldspar and rock fragments	2.4	2.7
Boulder clay	Clay, silty, grey-brown, compact, pebbly with frequent cobbles	5.3+	8.0
	Borehole abandoned due to rock obstruction		

GRADING

Mean for Deposit				Depth below surface (m)		Bulk Samples Percentages						
	%	mm	%	From	To	Fines	Sand			Gravel		
						-1/16	-¼+1/16	-1+¼	-4+1	-16+4	-64+16	+64
		+ 64	0	0.3	1.0	6	39	53	1	1	0	0
Gravel	2	- 64 + 16	1	1.0	2.0	3	61	36	trace	trace	0	0†
		- 16 + 4	1	2.0	2.7	8	53	30	2	3	4	0†
				Mean		5	52	40	1	1	1	0
		- 4 + 1	1									
Sand	93	- 1 + ¼	40									
		- ¼ + 1/16	52									
Fines	5	- 1/16	5									

NS 63 NW 76 6427 3746 Holms Farm, Avondale Block C

Surface level +192.7 m (+632 ft)
Ground water level +190.7 m
Shell 300 mm, 250 mm and 200 mm diameter
November 1975

Overburden 0.5 m
Mineral 4.7 m
Waste 16.1 m+

LOG

Geological Classification		Lithology	Thickness m	Depth m
		Soil, brown, pebbly	0.5	0.5
Alluvium	(a)	Gravel Gravel: coarse and fine, subrounded, basalt and sandstone Sand: fine to coarse, rock fragments and quartz	3.5	4.0
Glacial lake deposit	(b)	'Very clayey' sand Sand: fine, quartz, micaceous, grey Fines: clay	1.2	5.2
		Clay, silty, dark grey, laminated in parts, with sandy bands, composed mainly of fine quartz, from 14.5 to 16.3 m, 17.3 to 18.3 m and 19.3 to 20.3 m	15.1	20.3
Glacial sand and gravel		Sandy gravel Gravel: coarse and fine, subrounded, basalt, sandstone and quartz Sand: medium, coarse and fine, angular to subangular, quartz and rock fragments with coaly particles	1.0+	21.3
		Borehole abandoned due to rising sand		

GRADING

Mean for Deposit

(a&b) %	mm	%	Depth below surface (m) From	To	Bulk Samples: Fines -1/16	Sand -¼+1/16	Sand -1+¼	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
	+ 64	3 (a)	0.5	2.0	0	7	12	11	18	43	9
Gravel 46	- 64 + 16	27	2.0	3.2	6	9	12	11	23	39	0
	- 16 + 4	16	3.2	4.0	9	26	22	6	21	16	0
			Mean		3	12	14	10	21	36	4
	- 4 + 1	8									
Sand 44	- 1 + ¼	15 (b)	4.0	5.2	29	55	15	1	0	0	0†
	- ¼ + 1/16	21									
			14.5	16.3	38	37	5	4	11	5	0† ‡
Fines 10	- 1/16	10	16.3	17.3	Clay						
			17.3	18.3	33	59	5	1	2	0	0† ‡
			18.3	19.3	Clay						
			19.3	20.3	32	42	16	5	3	2	0† ‡
			20.3	21.3	5	19	29	17	16	14	0† ‡

‡ Non-mineral: not considered in calculation of mean grading

Surface level +197.0 m (+646 ft)
Ground water level +195.7 m
Shell 250 mm and 200 mm diameter
March 1976

Overburden 0.6 m
Mineral 24.0 m
Waste 0.4 m+

LOG

Geological Classification		Lithology	Thickness m	Depth m
		Sandy soil, mid-brown	0.6	0.6
Alluvium	(a)	'Clayey' sandy gravel, brown Gravel: fine to coarse with cobbles, basalt, quartzite and quartz Sand: fine to coarse, quartz Fines: silt	3.0	3.6
Glacial sand and gravel	(b)	Sandy gravel with rare clay bands Gravel: fine to coarse with rare cobbles, rounded to well rounded, quartz, quartzite, sandstone and basalt Sand: fine to coarse, quartz and rock fragments, grey-brown	12.0	15.6
	(c)	Sand Sand: medium to fine with coarse, grey-brown	4.0	19.6
Glacial lake deposit	(d)	'Very clayey' sand Sand: fine with medium and coarse, grey, with numerous coal fragments and rare, thin, clay laminae	5.0	24.6
		Silt, grey, with fine sand and coal fragments	0.4+	25.0

GRADING

Mean for Deposit (b to c)	%	mm	%		Depth below surface (m) From	To	Bulk Samples Percentages: Fines -1/16	Sand -¼+1/16	Sand -1+¼	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
		+ 64	0	(a)	0.6	1.6	11	10	10	11	18	40	0
Gravel	28	- 64 + 16	11		1.6	2.6	15	12	22	16	22	13	0 †
		- 16 + 4	17		2.6	3.6	13	8	26	14	22	17	0 †
					Mean		13	10	19	14	21	23	0
		- 4 + 1	14										
Sand	69	- 1 + ¼	34	(b)	3.6	4.6	6	14	42	15	13	10	0 †
		- ¼ + 1/16	21		4.6	5.6	3	17	35	15	15	15	0 †
					5.6	6.6	2	7	17	29	37	8	0 †
Fines	3	- 1/16	3		6.6	7.6	1	12	31	18	25	13	0 †
					7.6	8.6	trace	13	33	15	21	18	0 †
(a to d)					8.6	9.6	1	11	32	22	27	7	0 †
		+ 64	0		9.6	10.6	trace	5	20	19	35	21	0 †
Gravel	24	- 64 + 16	10		10.6	11.6	1	8	25	19	27	20	0 †
		- 16 + 4	14		11.6	12.6	2	7	23	19	30	19	0 †
					12.6	13.6	1	10	27	13	18	31	0 †
		- 4 + 1	11		13.6	14.6	8	17	36	13	19	7	0 †
Sand	68	- 1 + ¼	28		14.6	15.6	1	26	47	11	6	9	0 †
		- ¼ + 1/16	29		Mean		2	12	31	17	23	15	0
Fines	8	- 1/16	8	(c)	15.6	16.6	1	49	46	3	1	0	0 †
					16.6	17.6	5	47	39	6	3	0	0 †
					17.6	18.6	3	43	49	4	1	0	0 †
					18.6	19.6	2	48	46	3	1	0	0 †
					Mean		3	47	45	4	1	0	0
				(d)	19.6	20.6	12	44	40	3	1	0	0 †
					20.6	21.6	21	62	14	2	1	0	0 †
					21.6	22.6	20	74	6	trace	trace	0	0 †
					22.6	23.6	32	67	trace	1	0	0	0 †
					23.6	24.6	26	72	2	trace	trace	0	0 †
					Mean		22	64	13	1	trace	0	0

Surface level +219.2 m (+719 ft)
Ground water level +209.2 m
Shell 250 mm and 200 mm diameter
December 1975

Overburden 0.5 m
Mineral 13.5 m
Waste 11.3 m+

LOG

Geological Classification		Lithology	Thickness m	Depth m
		Soil, brown, sandy	0.5	0.5
Glacial sand and gravel	(a)	Gravel Gravel: fine and coarse with cobbles, angular to rounded, basalt, buff and red sandstone with felsite, granite and quartz Sand: fine to coarse, rock fragments and quartz	11.0	11.5
	(b)	Sand Sand: medium with fine, quartz with coaly fragments	2.5	14.0
Glacial lake deposit		Clay, dark brown, laminated, with micaceous partings and rare pebbles of basalt	2.3	16.3
Boulder clay		Clay, sandy, dark grey, stiff, with clasts of basalt	4.4	20.7
Glacial lake deposit		Clay, dark grey, stiff, laminated, silty in parts with rare pebbles	4.6+	25.3

GRADING

Mean for Deposit (a&b)	%	mm	%		Depth below surface (m) From	To	Fines -1/16	Bulk Samples Percentages Sand -¼+1/16	Sand -1+¼	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
		+ 64	16	(a)	0.5	1.8	3	6	11	12	15	29	24
Gravel	47	- 64 + 16	18		1.8	2.8	5	7	17	13	20	26	12
		- 16 + 4	13		2.8	3.8	5	7	13	10	19	26	20
					3.8	4.8	2	12	18	16	23	23	6
		- 4 + 1	9		4.8	5.8	6	15	27	12	18	14	8
Sand	50	- 1 + ¼	26		5.8	6.9	2	10	11	5	16	32	24
		- ¼ + 1/16	15		6.9	8.2	1	12	13	3	6	20	45
					8.2	8.8	trace	6	12	7	15	16	44
Fines	3	- 1/16	3		8.8	10.0	2	8	23	18	25	16	8†
					10.0	11.0	3	21	32	10	9	16	9†
					11.0	11.5	1	21	21	6	11	22	18†
					Mean		3	11	18	10	16	22	20
				(b)	11.5	12.5	3	45	52	trace	0	0	0†
					12.5	14.0	1	26	66	6	1	0	0†
					Mean		2	33	61	3	1	0	0

NS 63 NW 79 | 6493 3557 | Bankend Farm, Glengavel | Block E

Surface level +253.0 m (+830 ft)
Water not struck
Shell 300 mm, 250 mm and 200 mm diameter
November 1975

Overburden 0.3 m
Mineral 15.1 m
Waste 1.1 m
Mineral 5.8 m
Waste 2.7 m+

LOG

Geological Classification		Lithology	Thickness m	Depth m
		Soil	0.3	0.3
Glacial sand and gravel	(a)	Pebbly sand with rare silt bands Gravel: fine to coarse with cobbles, angular to well rounded, basalt, sandstone and quartz with rock fragments Sand: fine to medium with coarse, angular to subangular quartz and rock fragments, reddish brown to mid-brown Fines: clay with silt	15.1	15.4
Glacial lake deposit		Clay, laminated, silty, with fine sand bands, pebbly	1.1	16.5
Glacial sand and gravel	(b)	'Clayey' sand Gravel: fine, with rare, rounded pebbles and cobbles Sand: fine to medium with coarse, mid-brown subrounded and angular	5.8	22.3
Boulder clay		Clay, sandy, stony with rare cobbles of sandstone and basalt	2.7+	25.0

GRADING

Mean for Deposit (a&b)	%	mm	%		Depth below surface (m) From	To	Bulk Samples Percentages: Fines -1/16	Sand -¼+1/16	Sand -1+¼	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
		+ 64	trace	(a)	0.3	1.2	5	21	33	17	16	8	0
Gravel	12	- 64 + 16	5		1.2	2.2	10	33	29	12	13	3	0
		- 16 + 4	7		2.2	3.0	6	19	55	10	7	3	0
					3.0	4.0	8	16	29	8	16	23	0
		- 4 + 1	7		4.0	5.0	2	38	39	5	9	7	0
Sand	77	- 1 + ¼	32		5.0	6.0	13	50	33	2	2	trace	0
		- ¼ + 1/16	38		6.0	7.0	21	68	9	trace	trace	2	0
					7.0	8.0	9	33	33	6	9	4	6
Fines	11	- 1/16	11		8.0	9.0	5	37	51	3	3	1	0
					9.0	10.0	6	16	25	16	23	14	0
					10.0	11.0	5	36	46	3	3	7	0
					11.0	12.0	7	52	27	5	4	5	0
					12.0	13.0	7	37	40	6	6	4	0
					13.0	14.0	6	32	52	6	3	1	0
					14.0	15.0	5	14	38	14	11	18	0
					15.0	15.4	5	15	29	11	17	23	0
					Mean		8	33	35	8	9	7	trace
				(b)	16.5	17.7	26	52	17	2	2	1	0
					17.7	18.2	8	25	47	12	8	trace	0
					18.2	19.3	25	50	17	4	4	0	0
					19.3	20.3	24	51	23	2	trace	0	0
					20.3	21.3	11	58	23	6	2	0	0
					21.3	22.3	11	63	14	5	6	1	0
					Mean		19	52	21	5	3	trace	0
					22.3	23.5	12	15	9	13	22	29	0 ‡
					23.5	24.4	17	13	12	20	23	15	0 ‡
					24.4	25.0	17	16	14	19	21	13	0 ‡

‡ Non-mineral: not considered in calculation of mean grading.

NS 63 NW 80A* 6132 3749 Loudoun Hill Pit, Upper Section Block C

Surface level +221.6 m (+727 ft)
Section dry
Sampling by hand
July 1976

Mineral 6.7 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Glacial sand and gravel	Gravel Gravel: fine and coarse with cobbles, rounded basalt, sandstone and quartz Sand: medium to coarse with fine	6.7+	6.7

GRADING

Mean for Deposit				Depth below surface (m)		Bulk Samples Percentages						
	%	mm	%	From	To	Fines	Sand			Gravel		
						-1/16	-$\frac{1}{4}$+1/16	-1+$\frac{1}{4}$	-4+1	-16+4	-64+16	+64
		+ 64	5	0	0.7	1	6	17	13	18	43	2
Gravel	59	- 64 + 16	35	0.7	1.7	1	11	14	7	15	36	16
		- 16 + 4	19	1.7	2.7	trace	2	8	11	18	48	13
				2.7	3.7	trace	4	26	21	23	26	0
		- 4 + 1	15	3.7	4.7	trace	4	18	14	24	40	0
Sand	40	- 1 + $\frac{1}{4}$	20	4.7	5.7	trace	5	23	19	20	33	0
		- $\frac{1}{4}$ + 1/16	5	5.7	6.7	trace	3	37	20	17	23	0
				Mean		1	5	20	15	19	35	5
Fines	1	- 1/16	1									

NS 63 NW 80B* 6115 3756 Loudoun Hill Pit, Middle Section Block C

Surface level +213.1 m (+699 ft)
Section dry
Sampling by hand
July 1976

Mineral 6.9 m+

LOG

Geological Classification		Lithology	Thickness m	Depth m
Glacial sand and gravel	(a)	Pebbly sand Gravel: fine and coarse, rounded, igneous rocks and sandstone Sand: fine and medium with coarse, with coaly bands	3.9	3.9
	(b)	'Clayey' sand Sand: fine with medium and coarse, with coaly bands Fines: silt	3.0+	6.9

GRADING

Mean for Deposit

(a&b)	%	mm	%
		+ 64	0
Gravel	5	- 64 + 16	3
		- 16 + 4	2
		- 4 + 1	3
Sand	88	- 1 + $\frac{1}{4}$	37
		- $\frac{1}{4}$ + 1/16	48
Fines	7	- 1/16	7

Bulk Samples Percentages

	Depth below surface (m) From	To	Fines -1/16	Sand -$\frac{1}{4}$+1/16	Sand -1+$\frac{1}{4}$	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
(a)	0	0.9	1	22	60	9	7	1	0
	0.9	1.9	1	19	54	5	5	16	0
	1.9	2.9	1	35	63	1	trace	0	0
	2.9	3.9	2	47	44	1	3	3	0
	Mean		1	31	55	4	4	5	0
(b)	3.9	4.9	8	65	27	trace	trace	0	0
	4.9	5.9	10	80	10	trace	0	0	0
	5.9	6.9	30	68	2	trace	0	0	0
	Mean		16	71	13	trace	trace	0	0

NS 63 NW 80C* 6114 3747 Loudoun Hill Pit, Lower Section Block C

Surface level +206.9 m (+679 ft)
Section dry
Sampling by hand
July 1976

Mineral 7.0 m+

LOG

Geological Classification		Lithology	Thickness m	Depth m
Glacial sand and gravel	(a)	Pebbly sand Gravel: fine, quartz, sandstone and quartzite Sand: fine and medium with coarse, quartz with coaly fragments, finely laminated	4.0	4.0
Glacial lake deposit	(b)	'Clayey' sand Sand: fine, quartz Fines: silt	3.0+	7.0

GRAVEL

Mean for Deposit.

(a&b)	%	mm	%
		+ 64	0
Gravel	1	- 64 + 16	0
		- 16 + 4	1
		- 4 + 1	2
Sand	87	- 1 + ¼	20
		- ¼ + 1/16	65
Fines	12	- 1/16	12

Bulk Samples Percentages

	Depth below surface (m) From	To	Fines -1/16	Sand -¼+1/16	Sand -1+¼	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
(a)	0	1.0	trace	19	70	9	2	0	0
	1.0	2.0	10	57	28	2	3	0	0
	2.0	3.0	10	81	9	trace	0	0	0
	3.0	4.0	6	71	23	trace	0	0	0
	Mean		6	57	32	3	2	0	0
(b)	4.0	5.0	24	72	4	trace	0	0	0
	5.0	6.0	18	79	3	0	0	0	0
	6.0	7.0	16	79	4	1	trace	0	0
	Mean		19	77	4	trace	trace	0	0

NS 63 NW 81* 6370 3798 South Torfoot Pit Section, Drumclog Block C

Surface level +204.8 m (+672 ft) Mineral 10.7 m+
Section dry
Sampling by hand
July 1976

LOG

Geological Classification		Lithology	Thickness m	Depth m
Glacial sand and gravel	(a)	Sand Gravel: rare, fine, rounded Sand: fine to medium with coarse, quartz and rock fragments	2.7	2.7
	(b)	Pebbly sand Gravel: mainly fine, rounded, sandstone and felsite Sand: medium with fine and coarse, quartz and rock fragments, with coaly fragments	5.0	7.7
	(c)	Sandy gravel Gravel: fine and coarse with rare cobbles, rounded, quartz, sandstone, felsite and basalt Sand: medium and coarse with fine	3.0+	10.7

GRADING

Mean for Deposit (a to c)	%	mm	%		Depth below surface (m) From	To	Fines -1/16	Bulk Samples Percentages Sand -¼+1/16	Sand -1+¼	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
		+64	0	(a)	0	0.7	1	50	44	3	2	0	0
Gravel	14	- 64 + 16	5		0.7	1.7	1	31	58	6	4	0	0
		- 16 + 4	9		1.7	2.7	1	25	67	4	3	0	0
					Mean		1	34	58	4	3	0	0
		- 4 + 1	11										
Sand	85	- 1 + ¼	56	(b)	2.7	3.7	1	25	51	12	9	2	0
		- ¼ + 1/16	18		3.7	4.7	1	17	55	20	7	0	0
					4.7	5.7	1	10	66	11	7	5	0
Fines	1	- 1/16	1		5.7	6.7	trace	10	66	8	9	7	0
					6.7	7.7	1	13	68	10	8	0	0
					Mean		1	15	61	12	8	3	0
				(c)	7.7	8.7	trace	4	31	16	29	20	0
					8.7	9.7	trace	6	44	18	10	22	0
					9.7	10.7	trace	14	64	12	8	2	0
					Mean		trace	8	46	16	15	15	0

NS 63 NW 82* 6454 3925 Snabe Pit Section, Drumclog Block D

Surface level +196.2 m (+644 ft) Mineral 8.3 m+
Section dry
Sampling by hand
July 1976

LOG

Geological Classification	Lithology	Thickness m	Depth m
Glacial sand and gravel	Pebbly sand with rare silty bands Gravel: fine and coarse, quartz, basalt, sandstone and felsite Sand: fine and medium with coarse, quartz and rock fragments, with coaly fragments	8.3+	8.3

GRADING

Mean for Deposit				Depth below surface (m)		Bulk Samples Percentages						
	%	mm	%	From	To	Fines	Sand			Gravel		
						-1/16	-$\frac{1}{4}$+1/16	-1+$\frac{1}{4}$	-4+1	-16+4	-64+16	+64
		+ 64	0	0	0.5	7	38	39	7	7	2	0
Gravel	11	- 64 + 16	4	0.5	1.3	1	1	28	26	29	15	0
		- 16 + 4	7	1.3	2.3	trace	2	59	24	12	3	0
				2.3	3.3	1	2	53	28	14	2	0
		- 4 + 1	11	3.3	4.3	1	15	73	8	3	0	0
Sand	86	- 1 + $\frac{1}{4}$	47	4.3	5.3	1	16	68	6	4	5	0
		- $\frac{1}{4}$ + 1/16	28	5.3	6.3	10	56	27	1	trace	6	0
				6.3	7.3	4	54	40	1	trace	1	0
Fines	3	- 1/16	3	7.3	8.3	4	65	30	1	trace	0	0
				Mean		3	28	47	11	7	4	0

NS 63 NE 1 | 6545 3900 | Holmhead Farm, Avondale | Block D

Surface level +186.3 m (+611 ft)
Ground water level +177.6 m
Shell 250 mm and 200 mm diameter
November 1975

Overburden 0.5 m
Mineral 5.5 m
Waste 14.6 m+

LOG

Geological Classification		Lithology	Thickness m	Depth m
		Soil, peaty	0.5	0.5
Glacial sand and gravel	(a)	Sandy gravel Gravel: mainly coarse with fine and cobbles, angular to subrounded, sandstone, basalt and quartz with quartzite Sand: medium and fine with coarse, quartz and rock fragments Fines: mainly silt	2.8	3.3
Glacial lake deposit	(b)	'Very clayey' sand Sand: fine, quartz, micaceous with coaly fragments Fines: mainly clay, orange-brown	2.7	6.0
		Silt, grey, micaceous with fine sand in parts	7.5	13.5
		Clay, dark greyish brown, stiff, laminated with rare nodules of limestone and quartzite pebbles	3.8	17.3
Boulder clay		Clay, sandy, dark grey, stiff below 20.0 m, with angular to rounded clasts of sandstone, basalt and quartzite	3.3+	20.6

Borehole abandoned due to rock obstruction

GRADING

Mean for Deposit (a&b) %	mm	%		Depth below surface (m) From	To	Bulk Samples Percentages: Fines -1/16	Sand -¼+1/16	Sand -1+¼	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
	+ 64	1	(a)	0.5	1.0	5	30	47	14	4	trace	0
Gravel 21	- 64 + 16	14		1.0	2.1	8	10	16	9	13	44	0
	- 16 + 4	6		2.1	3.3	10	32	10	10	10	23	5†
				Mean		8	24	19	11	10	26	2
	- 4 + 1	6										
Sand 57	- 1 + ¼	10	(b)	3.3	4.1	36	59	1	trace	1	3	0†
	- ¼ + 1/16	41		4.1	5.2	39	59	1	trace	trace	1	0†
				5.2	6.0	36	63	1	trace	trace	0	0†
Fines 22	- 1/16	22		Mean		37	60	1	1	trace	1	0

Surface level +209.5 (+687 ft)
Ground water level +206.6 m
Shell 250 mm diameter
January 1976

Waste 7.3 m
Bedrock 1.4 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Soil, clayey, mottled at depth	1.2	1.2
Boulder clay	Clay, sandy, stiff, dark reddish brown, with variously shaped clasts of fine grained basic igneous rocks	5.1	6.3
Glacial sand and gravel	Sand and gravel, pebble shape varied, mainly basalt	1.0	7.3
Carboniferous (Calciferous Sandstone Measures)	Basalt, amygdaloidal, with white, orange and pale green zeolites	1.4+	8.7

NS 63 NE 3 6511 3847 Middle Croft Farm, Avondale Block D

Surface level +185.7 m (+609 ft)
Water struck at +183.7 m
Shell 250 mm and 200 mm diameter
January 1976

Overburden 0.6 m
Mineral 2.4 m
Waste 12.0 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Soil, sandy	0.6	0.6
Alluvium	'Clayey' sandy gravel Gravel: fine to coarse, subrounded to well rounded Sand: fine to medium with coarse, mineral and rock fragments with some rootlets Fines: silt	2.4	3.0
Glacial lake deposit	Silt, laminated below 3.4 m, with fine sand and chocolate-brown clay bands	8.2	11.2
Boulder clay	Clay, sandy, stony, reddish brown to grey-brown	3.8+	15.0
	Borehole abandoned due to rock obstruction		

GRADING

Mean for Deposit				Depth below surface (m)		Bulk Samples Percentages						
	%	mm	%	From	To	Fines	Sand			Gravel		
						-1/16	-¼+1/16	-1+¼	-4+1	-16+4	-64+16	+64
		+ 64	0	0.6	1.6	14	29	28	9	16	4	0
Gravel	26	- 64 + 16	9	1.6	3.0	8	20	26	16	17	13	0†
		- 16 + 4	17	Mean		11	23	27	13	17	9	0
		- 4 + 1	13									
Sand	63	- 1 + ¼	27									
		- ¼ + 1/16	23									
Fines	11	- 1/16	11									

NS 63 NE 4 | 6525 3700 | South Halls Farm, Glengavel | Block E

Surface level +229.7 m (+754 ft)
Water not struck
Shell 250 mm diameter
January 1976

Waste 4.1 m
Bedrock 1.9 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Soil	1.1	1.1
Glacial sand and gravel	Pebbly sand, fine, quartz and rock fragments, silty with rare pebbles	0.5	1.6
Boulder clay	Clay, sandy, yellowish brown, stiff, becoming softer at depth, with clasts of basalt	2.5	4.1
Silurian	Sandstone, micaceous, carbonaceous, iron-stained	1.9+	6.0

Surface level +220.1 m (+722 ft)
Ground water level +208.5 m
Shell 250 mm and 200 mm diameter
February 1976

Overburden 4.7 m
Mineral 5.3 m
Waste 2.2 m
Mineral 10.8 m
Waste 2.0 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Soil, peaty	0.5	0.5
Glacial sand and gravel	Sandy gravel Gravel: coarse with fine, subrounded to rounded, basalt Sand: red, mainly fine quartz, with some coarse angular rock fragments Fines: clay	0.9	1.4
Glacial lake deposit	Clay, red-brown to brown, compact, laminated, silty in parts with rare, rounded pebbles of sandstone	3.3	4.7
Glacial sand and gravel	(a) 'Very clayey' sandy gravel Gravel: fine with coarse, subrounded to subangular, yellow sandstone, basalt and felsite Sand: mainly fine and medium with coarse, quartz and rock fragments Fines: clay	5.3	10.0
Glacial lake deposit	Clay, orange and brown, with fine sand in parts	2.2	12.2
	(b) 'Clayey' sand Sand: fine with medium, light brown, quartz, micaceous with some coaly fragments Fines: silt	10.8	23.0
Boulder clay	Clay, grey, compact with clasts of basalt, sandstone and quartz	2.0+	25.0

NS 63 NE 5 Cont'd

GRADING

Mean for Deposit (a&b)	%	mm	%		Depth below surface (m) From	To	Bulk Samples Percentages Fines -1/16	Sand -¼+1/16	Sand -1+¼	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
		+ 64	1		0.5	1.4	10	29	15	6	11	21	8 ‡
Gravel	7	- 64 + 16	3										
		- 16 + 4	3	(a)	4.7	5.7	31	39	11	3	5	2	9
					5.7	6.9	31	31	14	6	10	8	0
		- 4 + 1	2		6.9	7.8	18	26	16	7	11	14	8
Sand	77	- 1 + ¼	16		7.8	9.0	22	36	19	5	8	10	0
		- ¼ + 1/16	59		9.0	10.0	27	39	15	6	7	6	0
					Mean		26	34	15	6	8	8	3
Fines	16	- 1/16	16										
				(b)	12.2	13.2	9	89	2	0	0	0	0†
					13.2	16.1	10	89	1	trace	0	0	0†
					16.1	17.1	20	64	16	trace	trace	0	0†
					17.1	18.4	15	60	25	trace	trace	0	0†
					18.4	19.2	6	50	44	trace	trace	0	0†
					19.2	20.4	6	72	21	1	trace	0	0†
					20.4	21.8	6	61	29	3	1	0	0†
					21.8	23.0	14	60	22	3	1	0	0†
					Mean		11	71	17	1	trace	0	0

‡ Non-mineral: not considered in calculation of mean grading

NS 63 NE 6 | 6590 3556 | Near Water House, Glengavel | Block E

Surface level +247.8 m (+813 ft)
Water struck at +235.8 m
Shell 250 mm and 200 mm diameter
February 1976

Overburden 8.0 m
Mineral 12.1 m
Bedrock 0.4 m+

LOG

Geological Classification		Lithology	Thickness m	Depth m
Peat		Peat	0.4	0.4
Boulder clay		Clay, alternating red, brown and grey, compact with clasts of subrounded, purple sandstone and weathered, igneous material	7.6	8.0
Glacial sand and gravel	(a)	'Very clayey' pebbly sand Gravel: fine and coarse, rounded, purple sandstone, basalt and quartz Sand: fine to medium, red-brown, quartz Fines: clay	2.3	10.3
	(b)	Gravel Gravel: fine and coarse, subangular to subrounded basalt, sandstone and quartz Sand: fine to coarse rock fragments and quartz	4.2	14.5
	(c)	'Clayey' sand Sand: fine with medium, quartz, micaceous Fines: silt	3.6	18.1
	(d)	'Clayey' sandy gravel Gravel: fine to coarse with cobbles, angular to subrounded, red sandstone, basalt, and quartz with felsite Sand: fine and medium with coarse, rock fragments and quartz Fines: silt	2.0	20.1
Silurian		Sandstone, reddish purple, medium grained, quartz, micaceous	0.4+	20.5

GRADING

Mean for Deposit (a to d)	%	mm	%		Depth below surface (m) From	To	Bulk Samples Percentages: Fines -1/16	Sand -¼+1/16	Sand -1+¼	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
		+ 64	2	(a)	8.0	9.1	24	39	26	4	5	2	0
Gravel	23	- 64 + 16	8		9.1	10.3	23	35	18	7	10	7	0
		- 16 + 4	13		Mean		24	36	22	6	8	4	0
		- 4 + 1	8	(b)	10.3	11.3	13	19	22	10	20	16	0
Sand	64	- 1 + ¼	22		11.3	12.4	11	16	19	10	24	16	4†
		- ¼ + 1/16	34		12.4	13.6	4	11	17	13	31	24	0†
					13.6	14.5	6	14	22	14	32	12	0†
Fines	13	- 1/16	13		Mean		8	15	19	12	27	18	1
				(c)	14.5	18.1	14	52	28	4	2	0	0†
				(d)	18.1	19.4	15	42	13	2	7	8	13†
					19.4	20.1	4	27	22	11	14	11	11†
					Mean		11	35	17	7	9	9	12

NS 63 NE 7 6544 3537 Laigh Plewland, Glengavel Block E

Surface level +250.1 m (+821 ft)
Water not struck
Shell 250 mm diameter
December 1975

Overburden 0.5 m
Mineral 15.5 m+

LOG

Geological Classification		Lithology	Thickness m	Depth m
		Soil	0.5	0.5
Glacial sand and gravel	(a)	'Clayey' pebbly sand Sand: yellowish brown, fine and medium quartz, rare coaly partings and thin pebble bands of subrounded sandstone and quartz Fines: mainly silt	10.8	11.3
	(b)	Gravel Gravel: coarse and fine with cobbles, subangular to subrounded, basalt, sandstone and quartz with quartzite and limestone Sand: fine to coarse, quartz and rock fragments Fines: silt	4.7+	16.0

Borehole abandoned due to rock obstruction

GRADING

Mean for Deposit

(a&b)	%	mm	%
		+ 64	2
Gravel	21	- 64 + 16	10
		- 16 + 4	9
		- 4 + 1	8
Sand	65	- 1 + $\frac{1}{4}$	18
		- $\frac{1}{4}$ + 1/16	39
Fines	14	- 1/16	14

Bulk Samples Percentages

	Depth below surface (m) From	To	Fines -1/16	Sand -$\frac{1}{4}$+1/16	Sand -1+$\frac{1}{4}$	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
(a)	0.5	1.5	17	60	12	3	2	6	0
	1.5	2.5	21	52	22	3	trace	2	0
	2.5	3.7	16	46	23	9	4	2	0
	3.7	4.7	20	43	31	4	2	0	0
	4.7	6.0	15	53	21	5	5	1	0
	6.0	7.0	23	57	14	2	2	2	0
	7.0	8.0	19	59	15	1	1	5	0
	8.0	9.2	18	62	17	2	1	0	0
	9.2	10.3	12	39	26	7	8	8	0
	10.3	11.3	14	41	22	11	9	3	0
	Mean		18	51	20	5	3	3	0
(b)	11.3	12.3	9	23	18	10	19	21	0
	12.3	12.7	8	10	12	15	25	30	0
	12.7	13.5	9	10	13	17	20	24	7
	13.5	14.5	5	7	10	11	20	25	22
	14.5	16.0	5	8	15	15	22	29	6
	Mean		7	11	14	13	21	26	8

NS 63 NE 8 | 6614 3946 | Near West Dykes Farm, Avondale | Block D

Surface level +185.4 m (+608 ft)
Water struck at +181.9 m
Shell 250 mm and 200 mm diameter
November 1975

Overburden 0.5 m
Mineral 1.0 m
Waste 1.0 m
Mineral 1.5 m
Waste 20.0 m+

LOG

Geological Classification		Lithology	Thickness m	Depth m
		Soil	0.5	0.5
Alluvium	(a)	'Clayey' sandy gravel Gravel: fine to coarse, well rounded, quartz and igneous material with sandstone Sand: fine to coarse, subangular	1.0	1.5
		Clay, reddish brown, sandy with pebbles	1.0	2.5
Glacial sand and gravel	(b)	'Clayey' sandy gravel Gravel: fine to coarse Sand: medium to fine, reddish brown, becoming grey at base, with coaly fragments	1.5	4.0
Glacial lake deposit		Silt, mid-grey becoming grey-brown with depth, laminated, with bands of chocolate-brown clay and fine micaceous sand, rare small pebbles and limestone nodules	15.3	19.3
		'Very clayey' sand Sand: fine, mid-grey, micaceous Fines: silt	2.0	21.3
Boulder clay		Clay, compact, stiff, dark brown, with subrounded, blue-grey and green basalts, grey diorite and quartz clasts	2.7+	24.0
		Borehole abandoned due to rock obstruction		

GRADING

Mean for Deposit

% (a&b)	mm	%		Depth below surface (m) From	To	Bulk Samples Percentages: Fines -1/16	Sand -¼+1/16	Sand -1+¼	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
	+ 64	0	(a)	0.5	1.5	17	14	25	10	19	15	0†
Gravel 28	- 64 + 16	11										
	- 16 + 4	17	(b)	2.5	4.0	13	23	25	16	16	7	0†
	- 4 + 1	13		19.3	21.3	21	64	9	3	2	1	0†‡
Sand 58	- 1 + ¼	25										
	- ¼ + 1/16	20										
Fines 14	- 1/16	14										

‡ Non-mineral: not considered in calculation of mean grading

NS 63 NE 9 6797 3938 Nether Hawkwood, Avondale Block F_2

Surface level +243.7 m (+800 ft)
Water not struck
Shell 250 mm diameter
February 1976

Waste 6.3 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Soil, peaty	0.3	0.3
Boulder clay	Clay, sandy, weathered, bright reddish brown, stony	0.6	0.9
	Clay, very compact, blue-grey, with numerous igneous clasts	1.6	2.5
	Clay, sandy, reddish brown, stony	3.8+	6.3
	Borehole abandoned due to rock obstruction		

Surface level +237.6 m (+780 ft)
Water not struck
Shell 250 mm and 200 mm diameter
February 1976

Overburden 0.5 m
Mineral 2.5 m
Waste 5.6 m
Bedrock <0.1 m

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Soil	0.5	0.5
Glacial sand and gravel	Gravel Gravel: cobbles, coarse and fine, subrounded to angular, basalt and red sandstone Sand: coarse and medium, angular rock fragments Fines: clay	2.5	3.0
Boulder clay	Clay, sandy, red, stiff, with clasts of basalt, sandstone and limestone	5.6	8.6
Carboniferous (Calciferous Sandstone Measures)	Basalt, porphyritic, weathered, grey	<0.1	8.6

GRADING

Mean for Deposit

	%	mm	%
		+ 64	25
Gravel	64	- 64 + 16	22
		- 16 + 4	17
		- 4 + 1	11
Sand	25	- 1 + $\frac{1}{4}$	8
		- $\frac{1}{4}$ + 1/16	6
Fines	11	- 1/16	11

Depth below surface (m)		Bulk Samples Percentages						
			Sand			Gravel		
From	To	Fines -1/16	-$\frac{1}{4}$+1/16	-1+$\frac{1}{4}$	-4+1	-16+4	-64+16	+64
0.5	1.5	7	4	6	10	15	21	37
1.5	2.0	13	7	9	11	19	31	10
2.0	3.0	14	8	8	13	17	19	21†
Mean		11	6	8	11	17	22	25

NS 63 NE 11 6955 3978 Lambhill Farm, Avondale Block F_2

Surface level +260.6 m (+855 ft)
Ground Water level +257.4 m
Shell 250 mm and 200 mm diameter
February 1976

Waste 5.2 m
Bedrock <0.1 m

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Soil, red-brown, sandy	0.6	0.6
Boulder clay	Clay, orange becoming grey with depth, silty with lenses of fine sand and plant fragments	0.9	1.5
	Clay, sandy, dark grey, stiff, with clasts of subrounded quartz, red sandstone and basalt	3.7	5.2
Silurian	Sandstone, greyish brown, fine grained, finely micaceous	<0.1	5.2

NS 63 NE 12* 6527 3619 Templeland Section, Glengavel Block E

Surface level +226.8 m (+744 ft)
Section dry
Sampling by hand
July 1976

Mineral 5.7 m
Waste 11.0 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Glacial lake deposit	'Clayey' pebbly sand with frequent fine silty laminae and band of poorly sorted gravel from 0 to 0.7 m Gravel: fine to coarse with cobbles, rounded, quartz, red sandstone and basalt Sand: fine with medium and coarse, quartz Fines: silt	5.7	5.7
	Silt, laminated, grey with frequent thin fine sand laminae and 'pebbly sand' from 8.2 to 8.7 m, micaceous, becoming stiff at depth	3.0	8.7
Boulder clay	Clay, with clasts, dark grey	8.0+	16.7

GRADING

Mean for Deposit				Depth below surface (m)		Bulk Samples Percentages						
	%	mm	%	From	To	Fines	Sand			Gravel		
						-1/16	-¼+1/16	-1+¼	-4+1	-16+4	-64+16	+64
		+ 64	2	0	0.7	1	4	13	14	23	30	15
Gravel	10	- 64 + 16	4	0.7	1.7	30	68	2	trace	trace	0	0
		- 16 + 4	4	1.7	2.7	34	65	1	trace	trace	0	0
				2.7	3.7	14	84	2	trace	0	0	0
		- 4 + 1	2	3.7	4.7	14	85	1	trace	0	0	0
Sand	72	- 1 + ¼	4	4.7	5.7	7	73	12	2	4	2	0
		- ¼ + 1/16	66	Mean		18	66	4	2	4	4	2
Fines	18	- 1/16	18	8.2	8.7	5	18	46	15	13	3	0 ‡

‡ Non-mineral: not considered in calculation of mean grading

NS 63 NE 13* 6512 3572 Bankend Section, Glengavel Block E

Surface level +228.4 m (+749 ft)
Section dry
Sampling by hand
July 1976

Mineral 15.5 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Glacial sand and gravel	Gravel with rare silt and clay bands Gravel: fine and coarse with cobbles, subrounded to well rounded, basalt, red and yellow sandstone, quartzite, quartz and felsite Sand: medium and coarse with fine, rock fragments and quartz	15.5+	15.5

GRADING

Mean for Deposit

	%	mm	%
		+ 64	4
Gravel	55	- 64 + 16	33
		- 16 + 4	18
		- 4 + 1	14
Sand	43	- 1 + $\frac{1}{4}$	21
		- $\frac{1}{4}$ + 1/16	8
Fines	2	- 1/16	2

Bulk Samples Percentages

Depth below surface (m) From	To	Fines -1/16	Sand -$\frac{1}{4}$+1/16	Sand -1+$\frac{1}{4}$	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
0	1.0	1	12	43	15	9	20	0
1.0	2.0	3	2	13	17	25	40	0
2.0	3.0	1	1	12	11	21	54	0
3.0	4.0	4	3	23	25	19	26	0
4.0	5.0	4	3	14	11	14	49	5
5.0	6.0	trace	5	24	16	21	34	0
6.0	7.0	trace	2	7	10	18	51	12
7.0	8.5	2	12	33	15	22	16	0
8.5	9.5	1	7	28	27	22	15	0
9.5	10.5	2	9	28	9	13	24	15
10.5	11.5	1	6	21	11	24	33	4
11.5	12.5	2	3	17	11	17	50	0
12.5	13.5	3	7	11	11	17	44	7
13.5	14.5	1	9	17	8	20	30	15
14.5	15.5	4	32	23	11	15	15	0
Mean		2	8	21	14	18	33	4

NS 63 NE 14* 6563 3527 Laigh Plewland Section, Glengavel Block E

Surface level +269.2 m (+883 ft)
Section dry
Sampling by hand
July 1976

Mineral 8.4 m
Waste 3.5 m
Mineral 22.6 m
Waste 11.3 m+

LOG

Geological Classification		Lithology	Thickness m	Depth m
Glacial sand and gravel	(a)	Gravel Gravel: fine to coarse with cobbles, poorly sorted, well rounded, basalt and quartz Sand: medium to coarse with fine, quartz	1.0	1.0
		Section obscured, probably gravel	2.9	3.9
	(b)	Sand Gravel: fine, basalt Sand: fine to medium with coarse, quartz, orange Fines: silt	4.5	8.4
Glacial lake deposit		Silt, stiff, laminated, grey	3.5	11.9
Glacial sand and gravel	(c)	'Very clayey' sand with brown, laminated silt from 12.8 to 13.8 m Sand: fine to medium with coarse, quartz and rock fragments Fines: silt	9.1	21.0
	(d)	Sandy gravel with frequent thin red brown stiff till bands Gravel: fine to coarse, well rounded basalt, red micaceous sandstone, with quartz and quartzite Sand: fine to coarse, quartz and rock fragments	1.9	22.9
	(e)	'Clayey' pebbly sand, finely bedded, with thin bands of boulder clay and gravel, and silty partings; section obscured from 27.9 to 28.9 m Gravel: fine to coarse, quartz, quartzite, sandstone and basalt with felsite Sand: fine to medium with coarse, rock fragments and quartz with coal fragments Fines: clay and silt	11.6	34.5
Boulder clay		Clay, stiff, grey with igneous clasts	11.3+	45.8

GRADING

Mean for Deposit (a&b)	%	mm	%		Depth below surface (m) From	To	Bulk Samples Percentages Fines -1/16	Sand -¼+1/16	Sand -1+¼	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
		+ 64	1	(a)	0	1.0	1	2	21	22	23	28	3
Gravel	12	- 64 + 16	6		1.0	3.9	Section obscured						
		- 16 + 4	5										
				(b)	3.9	4.8	5	18	59	7	6	5	0
		- 4 + 1	5		4.8	5.7	7	59	34	trace	trace	0	0
Sand	82	- 1 + ¼	28		5.7	6.6	9	69	19	2	1	0	0
		- ¼ + 1/16	49		6.6	7.5	8	79	13	trace	trace	0	0
					7.5	8.4	7	71	21	1	trace	trace	0
Fines	6	- 1/16	6		Mean		7	59	29	2	2	1	0
(c to e)				(c)	11.9	12.8	33	66	1	trace	trace	0	0
		+ 64	0		12.8	13.8	Silt						
Gravel	13	- 64 + 16	6		13.8	14.7	12	35	45	7	trace	1	0
		- 16 + 4	7		14.7	15.6	38	56	6	trace	trace	0	0
					15.6	16.5	30	51	15	2	2	trace	0
		- 4 + 1	5		16.5	17.4	16	39	32	11	2	trace	0
Sand	70	- 1 + ¼	23		17.4	18.3	31	46	11	3	3	6	0
		- ¼ + 1/16	42		18.3	19.2	21	46	28	4	1	trace	0
					19.2	20.1	16	38	35	7	3	1	0
Fines	17	- 1/16	17		20.1	21.0	13	41	35	3	3	5	0
					Mean		24	46	23	4	2	1	0
(a to e)													
		+ 64	trace	(d)	21.0	21.9	8	28	22	10	16	16	0
Gravel	12	- 64 + 16	6		21.9	22.9	7	22	21	10	18	22	0
		- 16 + 4	6		Mean		8	25	21	10	17	19	0
		- 4 + 1	6	(e)	22.9	23.9	18	46	21	4	7	4	0
Sand	73	- 1 + ¼	24		23.9	24.9	17	46	25	4	6	2	0
		- ¼ + 1/16	43		24.9	25.9	8	23	24	11	18	16	0
					25.9	26.9	19	42	25	6	7	1	0
Fines	15	- 1/16	15		26.9	27.9	24	50	12	3	5	6	0
					27.9	28.9	Section obscured						
					28.9	29.7	14	67	13	2	3	1	0
					29.7	30.5	9	29	23	14	20	5	0
					30.5	31.3	13	44	30	6	5	2	0
					31.3	32.1	12	42	19	6	7	14	0
					32.1	32.9	9	37	31	4	11	8	0
					32.9	33.7	13	42	25	4	6	10	0
					33.7	34.5	10	33	30	7	8	12	0
					Mean		14	42	23	6	8	7	0

NS 63 SW 1 | 6450 3469 | Small Burn, Glengavel | Block E

Surface level c +261 m (c +856 ft)
Ground water level c +251 m
Shell 250 mm and 200 mm diameter
January 1976

Overburden 0.5 m
Mineral 24.5 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Soil, sandy	0.5	0.5
Glacial sand and gravel	(a) Pebbly sand Gravel: fine with coarse, subrounded to rounded, sandstone and basalt Sand: fine and medium, with coarse, quartz, micaceous, with some angular rock fragments Fines: silt and clay bands	3.0	3.5
	(b) Sandy gravel Gravel: fine and coarse with cobbles, subrounded to well rounded with some angular, quartz, sandstone, quartzite, granite, greywacke and basalt Sand: fine to coarse, subrounded to rounded quartz and rock fragments Fines: silt, brown	9.0	12.5
	(c) Gravel Gravel: fine and coarse with cobbles, rounded, quartz, basalt, quartzite, felsite, sandstone, greywacke and schist Sand: medium and coarse with fine, angular, quartz and rock fragments with coaly fragments below 21.0 m	9.7	22.2
	(d) Sand, with rare pebbles Sand: fine to medium with coarse, subrounded, quartz with coaly fragments, micaceous	2.8+	25.0

GRADING

Mean for Deposit (a to d)	%	mm	%		Depth below surface (m) From	To	Bulk Samples Percentages: Fines -1/16	Sand -¼+1/16	Sand -1+¼	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
		+ 64	3	(a)	0.5	1.5	11	47	32	6	3	1	0
Gravel	35	- 64 + 16	15		1.5	2.5	7	21	47	12	11	2	0
		- 16 + 4	17		2.5	3.5	6	26	59	7	2	0	0
					Mean		8	32	46	8	5	1	0
		- 4 + 1	14										
Sand	60	- 1 + ¼	29	(b)	3.5	4.5	5	21	37	10	9	7	11
		- ¼ + 1/16	17		4.5	5.5	6	18	37	11	13	5	10
					5.5	6.5	7	16	23	12	21	21	0
Fines	5	- 1/16	5		6.5	7.5	21	45	26	2	2	4	0
					7.5	8.5	8	20	20	17	22	13	0
					8.5	9.5	6	7	26	25	27	9	0
					9.5	10.5	5	6	38	20	21	10	0
					10.5	11.5	3	6	29	28	20	14	0
					11.5	12.5	7	5	24	31	21	12	0†
					Mean		8	16	29	17	17	11	2
				(c)	12.5	13.5	2	5	16	17	35	25	0†
					13.5	14.5	4	13	23	22	24	14	0†
					14.5	16.0	3	8	15	15	18	30	11†
					16.0	17.0	3	6	15	26	24	21	5†
					17.0	18.0	2	7	11	17	29	34	0†
					18.0	19.0	3	4	7	8	32	46	0†
					19.0	20.0	2	3	6	8	33	41	7†
					20.0	21.0	1	6	13	13	26	31	10†
					21.0	22.2	3	19	37	11	7	11	12†
					Mean		3	8	16	15	25	28	5
				(d)	22.2	23.2	4	39	52	5	trace	0	0†
					23.2	24.2	4	42	51	3	trace	0	0†
					24.2	25.0	4	35	50	8	3	trace	0†
					Mean		4	39	51	5	1	trace	0

NS 63 SW 2 | 6403 3425 | Woollen Burn, Glengavel | Block E

Surface level +274.3 m (+900 ft)
Ground water level +270.2 m
Shell 250 mm and 200 mm diameter
January 1976

Overburden 0.8 m
Mineral 4.4 m
Waste 8.0 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Peat	Peat	0.8	0.8
Glacial sand and gravel	'Clayey' sandy gravel Gravel: fine and coarse with cobbles, angular to rounded sandstone, basalt, granite and quartz Sand: coarse with fine and medium, angular quartz Fines: clay	4.4	5.2
Boulder clay	Clay, brown, sandy, stiff, becoming blue-grey below 9.3 m, with clasts of sandstone, basalt and quartz	8.0+	13.2
	Borehole abandoned due to rock obstruction		

GRADING

Mean for Deposit

	%	mm	%
		+ 64	5
Gravel	42	- 64 + 16	16
		- 16 + 4	21
		- 4 + 1	18
Sand	44	- 1 + $\frac{1}{4}$	14
		- $\frac{1}{4}$ + 1/16	12
Fines	14	- 1/16	14

Depth below surface (m) From	To	Bulk Samples Percentages Fines -1/16	Sand -$\frac{1}{4}$+1/16	Sand -1+$\frac{1}{4}$	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
0.8	3.1	15	14	16	17	15	16	7
3.1	4.0	12	12	11	14	22	23	6
4.0	5.2	13	10	12	23	31	11	0 †
Mean		14	12	14	18	21	16	5

NS 63 SE 1 | 6580 3459 | High Plewland, Glengavel | Block E

Surface level +265.1 m (+870 ft)
Ground water level +251.9 m
Shell 250 mm and 200 mm diameter
January 1976

Overburden 0.4 m
Mineral 20.1 m
Bedrock 0.1 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
Glacial sand and gravel	'Very clayey' sandy gravel, with increasing gravel content below 12.3 m Gravel: coarse and fine with some cobbles, subrounded to sub-angular, sandstone with quartz Sand: fine with medium, yellow-brown, rounded, quartz, micaceous with coaly fragments in parts Fines: clay and rare silty bands	20.1	20.5
Post-Devonian (Old Red Sandstone) intrusion	Quartz dolerite, light grey, medium grained	0.1+	20.6

GRADING

Mean for Deposit

	%	mm	%
		+ 64	2
Gravel	7	- 64 + 16	3
		- 16 + 4	2
		- 4 + 1	2
Sand	72	- 1 + $\frac{1}{4}$	21
		- $\frac{1}{4}$ + 1/16	49
Fines	21	- 1/16	21

Bulk Samples Percentages

Depth below surface (m) From	To	Fines -1/16	Sand -$\frac{1}{4}$+1/16	Sand -1+$\frac{1}{4}$	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
0.4	1.3	32	53	14	1	trace	trace	0
1.3	2.3	28	48	24	trace	trace	0	0
2.3	3.2	22	48	19	1	1	9	0
3.2	4.4	20	58	19	3	trace	trace	0
4.4	5.4	15	43	37	3	2	0	0
5.4	6.4	12	53	29	2	1	3	0
6.4	7.4	14	35	49	2	trace	0	0
7.4	8.4	27	47	24	1	1	0	0
8.4	9.3	17	26	55	2	trace	0	0
9.3	10.3	27	62	11	trace	trace	0	0
10.3	11.3	20	58	15	2	5	trace	0
11.3	12.3	28	57	12	1	2	trace	0 †
12.3	13.4	24	59	10	1	3	3	0 †
13.4	14.4	15	60	14	2	3	6	0 †
14.4	15.4	14	39	19	2	1	0	25 †
15.4	16.6	13	49	30	2	3	3	0 †
16.6	17.6	19	50	16	2	6	7	0 †
17.6	18.6	13	43	16	2	5	5	16 †
18.6	19.6	28	40	8	2	6	16	0 †
19.6	20.5	25	55	11	2	3	4	0 †
Mean		21	49	21	2	2	3	2

Surface level +284.8 m (+934 ft)
Water not struck
Shell 250 mm diameter
January 1976

Overburden 0.3 m
Mineral 3.2 m
Waste 1.0 m
Mineral 3.0 m
Waste 1.0 m+

LOG

Geological Classification		Lithology	Thickness m	Depth m
Peat		Peat	0.3	0.3
Glacial sand and gravel	(a)	'Very clayey' sandy gravel Gravel: coarse and fine with cobbles, rounded to subangular, red sandstone with granite and basalt Sand: fine with medium and coarse, rock fragments, red Fines: clay	3.2	3.5
		Clay, silty, dark brown	1.0	4.5
	(b)	'Very clayey' sandy gravel, sandy at top Gravel: fine, coarse and cobbles, angular to subrounded, greywacke and red sandstone with basalt Sand: fine with medium, angular, rock fragments and quartz Fines: silt and clay, dark brown	3.0	7.5
Boulder clay		Clay, sandy, reddish brown, with clasts of sandstone and quartz	1.0+	8.5

Borehole abandoned due to rock obstruction

GRADING

Mean for Deposit (a&b)					Depth below surface (m)		Bulk Samples Percentages						
	%	mm	%		From	To	Fines	Sand			Gravel		
							-1/16	+¼-1/16	-1+¼	-4+1	-16+4	-64+16	+64
		+ 64	7	(a)	0.3	1.3	15	21	16	8	15	16	9
Gravel	25	- 64 + 16	9		1.3	2.5	17	28	14	8	12	11	10
		- 16 + 4	9		2.5	3.5	28	36	17	5	7	7	0
					Mean		20	28	16	7	11	12	6
		- 4 + 1	5										
Sand	53	- 1 + ¼	14	(b)	4.5	5.5	32	54	12	trace	1	1	0
		- ¼ + 1/16	34		5.5	6.5	20	37	16	3	6	7	11
					6.5	7.5	23	30	12	6	10	11	8
Fines	22	- 1/16	22		Mean		25	40	13	3	6	6	7

Surface level +274.9 m (+902 ft)
Water struck at +272.2 m
Shell 250 mm diameter
January 1976

Overburden 0.7 m
Mineral 7.3 m
Waste 2.2 m
Bedrock 0.6 m+

LOG

Geological Classification		Lithology	Thickness m	Depth m
		Soil	0.7	0.7
Alluvium on glacial sand and gravel	(a)	Gravel Gravel: coarse and fine with cobbles, purple and grey, rounded, sandstone and quartzite Sand: fine to coarse, angular, rock fragments and quartz Fines: mainly clay	2.0	2.7
	(b)	'Clayey' sandy gravel Gravel: fine, rounded, quartz and basalt Sand: fine and medium quartz, micaceous with coaly fragments Fines: clay, light brown	3.7	6.4
	(c)	Gravel Gravel: coarse and fine, rounded, quartz, greywacke, sandstone and basalt with felsite Sand: fine to coarse, quartz, micaceous with coaly fragments	1.6	8.0
Boulder clay		Clay, light brown, stiff, stony	2.2	10.2
Silurian		Conglomerate, weathered, grey	0.6+	10.8

GRADING

Mean for Deposit (a to c)			%		Depth below surface (m) From	To	Bulk Samples Percentages Fines -1/16	Sand -¼+1/16	Sand -1+¼	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
		+ 64	2	(a)	0.7	1.7	9	10	11	7	13	39	11
Gravel	31	- 64 + 16	16		1.7	2.7	9	13	21	19	18	14	6
		- 16 + 4	13		Mean		9	11	16	13	16	27	8
		- 4 + 1	9	(b)	2.7	4.4	11	45	34	5	5	trace	0†
Sand	57	- 1 + ¼	24		4.4	5.2	8	37	43	5	5	2	0†
		- ¼ + 1/16	24		5.2	6.4	31	28	22	5	9	5	0†
					Mean		17	38	32	5	6	2	0
Fines	12	- 1/16	12										
				(c)	6.4	7.5	1	9	14	12	24	40	0†
					7.5	8.0	6	4	15	16	25	34	0†
					Mean		2	7	15	14	24	38	0

NS 64 SW 1 | 6494 4068 | Hallburn Farm, Avondale | Block F_1

Surface level +212.8 m (+698 ft)
Water not struck
Shell 250 mm diameter
February 1976

Waste 11.5 m
Bedrock 0.3 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Boulder clay	Clay, sandy, dark grey-brown, weathered orange-brown at top compact, with clasts of reddish grey sandstone and basic igneous rocks	3.7	4.0
	Clay, sandy, dark brown with reddish tinge, becoming dark grey-brown below 9.0 m, with subrounded to rounded clasts of basalt	7.5	11.5
Carboniferous (Calciferous Sandstone Measures)	Basalt, amygdaloidal, with calcite veining, dark grey	0.3+	11.8

NS 64 SE 4 | 6533 4174 | Over Brownside, Caldermill, Avondale | Block F_1

Surface level +224.0 m (+735 ft)
Ground water level +221.2 m
Shell 250 mm diameter
February 1976

Waste 6.6 m
Bedrock 0.1 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Made ground	0.5	0.5
Boulder clay	Clay, sandy, blue-grey to dark grey, orange-brown and weathered at top, becoming stiffer at depth, with sub-rounded to subangular clasts of basalt, cream sandstone, dolerite and shelly limestone	2.6	3.1
	Clay, sandy, very stiff, dark reddish brown, with clasts	3.5	6.6
Carboniferous (Calciferous Sandstone Measures)	Basalt, grey, rare phenocrysts	0.1+	6.7

NS 64 SE 5 | 6591 4085 | Roundhill Farm, Avondale | Block D

Surface level +181.3 m (+595 ft)
Water struck at +174.1 m (Artesian)
Shell 250 mm diameter
February 1976

Waste 10.7 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Alluvium	Clay, yellow-brown with clasts of sandstone	0.6	0.9
Glacial lake deposit	Silt, laminated, mid-grey with bands of chocolate-brown clay and fine sand	4.7	5.6
Boulder clay	Clay, sandy, dark grey, with cream sandstone and coal clasts	1.6	7.2
Glacial sand and gravel	Gravel Gravel: fine to coarse, angular to well rounded, basalt, porphyry, sandstone and coal Sand: coarse to fine	1.1	8.3
Boulder clay	Clay, sandy, stony, reddish brown, with igneous and sandstone clasts	2.4+	10.7

Borehole abandoned due to rock obstruction

GRADING

Bulk Samples
Percentages

Depth below surface (m) From	To	Fines	Sand			Gravel		
		-1/16	-¼+1/16	-1+¼	-4+1	-16+4	-64+16	+64
7.2	8.3	6	9	13	15	38	19	0 † ‡
8.3	9.3	5	14	31	20	24	6	0 † ‡

‡ Non-mineral: not considered in calculation of mean grading

Surface level +206.1 m (+676 ft)
Water struck at +196.1 m
Shell, 250 mm and 200 mm diameter
February 1976

Overburden 0.5 m
Mineral 10.5 m
Waste 11.5 m+

LOG

Geological Classification		Lithology	Thickness m	Depth m
		Soil, dark brown, sandy	0.5	0.5
Glacial sand and gravel	(a)	Sandy gravel Gravel: fine with coarse, sub-rounded to well rounded, quartz common Sand: coarse to fine, subangular to subrounded quartz with rock fragments	2.6	3.1
	(b)	'Clayey' sand Sand: fine with medium, light brown, subangular to sub-rounded, quartz, feldspar and rock fragments with some coaly bands Fines: silt, orange-brown, micaceous with rare chocolate-brown clay laminae	7.9	11.0
Glacial lake deposit		Silt, mid-brown, micaceous	1.0	12.0
Boulder clay		Clay, sandy, dark grey-brown, with rounded basalt, sandstone and porphyry clasts and small coal fragments	10.5+	22.5

Borehole abandoned due to rock obstruction

GRADING

Mean for Deposit					Depth below surface (m)		Bulk Samples Percentages						
% (a & b)		mm	%		From	To	Fines -1/16	Sand -¼+1/16	Sand -1+¼	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
		+ 64	0	(a)	0.5	1.5	7	10	23	24	30	6	0
Gravel	8	- 64 + 16	1		1.5	2.5	6	11	31	28	22	2	0
		- 16 + 4	7		2.5	3.1	8	8	30	30	23	1	0
					Mean		7	10	27	27	26	3	0
		- 4 + 1	9										
Sand	78	- 1 + ¼	24	(b)	3.1	4.1	26	59	13	2	trace	0	0
		- ¼ + 1/16	45		4.1	5.1	21	58	17	2	2	0	0
					5.1	6.1	8	53	38	1	0	0	0
Fines	14	- 1/16	14		6.1	7.1	9	58	30	2	1	0	0
					7.1	8.1	22	42	25	8	3	0	0
					8.1	9.1	8	54	33	4	1	0	0
					9.1	10.0	12	62	24	2	trace	0	0
					10.0	11.0	32	60	8	trace	trace	0	0 †
					Mean		17	56	23	3	1	0	0

NS 64 SE 7 | 6641 4087 | Mid Linbank Farm, Avondale | Block D

Surface level +182.5 m (+599 ft)
Water struck at +181.0 m
Shell, 250 mm and 200 mm diameter
March 1976

Overburden 0.9 m
Mineral 1.0 m
Waste 18.7 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Made ground and subsoil, pebbly clay	0.9	0.9
Alluvium	Pebbly sand Gravel: fine with coarse, rounded to well rounded Sand: medium to coarse, orange-brown	1.0	1.9
Glacial lake deposit	Silt, micaceous, grey with reddish brown bands containing laminae of chocolate-brown clay	5.4	7.3
Boulder clay	Clay, very stiff, dark brown, becoming grey with depth, with clasts of igneous material and sandstone	13.3+	20.6
	Borehole abandoned due to rock obstruction		

GRADING

Mean for Deposit				Depth below surface (m)		Bulk Samples Percentages						
%	mm	%		From	To	Fines	Sand			Gravel		
						-1/16	-$\frac{1}{4}$+1/16	-1+$\frac{1}{4}$	-4+1	-16+4	-64+16	+64
	+ 64	0		0.9	1.9	4	7	42	24	18	5	0†
Gravel 23	- 64 + 16	5										
	- 16 + 4	18										
	- 4 + 1	24										
Sand 73	- 1 + $\frac{1}{4}$	42										
	- $\frac{1}{4}$ + 1/16	7										
Fines 4	- 1/16	4										

NS 64 SE 8 | 6600 4012 | Ryeland Bridge, Avondale | Block D

Surface level +182.1 m (+597 ft)
Water struck at +166.7 m (Artesian)
Shell, 250 mm and 200 mm diameter
February 1976

Waste 20.0 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Soil	1.0	1.0
Boulder clay	Clay, sandy, grey-brown becoming reddish brown, rounded to well rounded clasts	9.3	10.3
	Clay, sandy, dark grey-brown, stony with some cobbles	5.1	15.4
Glacial sand and gravel	Sandy gravel Gravel: fine to coarse with some cobbles, subangular to well rounded, sandstones, basalt, porphyry, quartz and rare schist Sand: coarse to fine, angular, mineral and rock fragments Fines: silt	3.7	19.1
Boulder clay	Clay, sandy, grey-brown, clasts varied, including greywacke	0.9+	20.0

Borehole abandoned due to rock obstruction

GRADING

Depth below surface (m) From	To	Bulk Samples Percentages Fines -1/16	Sand -1/4+1/16	Sand -1+1/4	Sand -4+1	Gravel -16+4	Gravel -64+16	Gravel +64
15.4	16.5	8	14	24	21	22	11	0† ‡
16.5	17.5	6	20	19	17	19	19	0† ‡
17.5	18.5	2	7	26	32	23	10	0† ‡
18.5	19.1	9	21	20	24	18	8	0† ‡

‡ Non-mineral: not considered in calculation of mean grading

Surface level +191.9 m (+630 ft)
Ground water level +182.6 m
Shell, 250 mm and 200 mm diameter
March 1976

Overburden 0.5 m
Mineral 8.0 m
Waste 8.6 m
Mineral 3.8 m
Waste 2.1 m+

LOG

Geological Classification		Lithology	Thickness m	Depth m
		Soil	0.5	0.5
Glacial sand and gravel	(a)	'Clayey' pebbly sand Gravel: fine to coarse, well rounded Sand: fine to medium with coarse, well sorted bands, light to mid-brown, subrounded, quartz with frequent coal fragments Fines: silt with clay	8.0	8.5
Glacial lake deposit		Silt, grey, sandy at top, with coaly fragments and rare pebbles, becoming clayey at depth	8.6	17.1
Glacial sand and gravel	(b)	Gravel with rare silt and clay bands Gravel: fine to coarse with cobbles, subrounded to well rounded, basalts, porphyry, sandstone and rare quartz Sand: coarse with medium and fine, with coal fragments	3.8	20.9
Boulder clay		Clay, sandy with clasts, rounded with some subangular, of varied composition	2.1+	23.0

Borehole abandoned due to rock obstruction

GRADING

Mean for Deposit					Depth below surface (m)		Bulk Samples Percentages						
	%	mm	%		From	To	Fines	Sand			Gravel		
(a&b)							-1/16	-¼+1/16	-1+¼	-4+1	-16+4	-64+16	+64
		+ 64	1	(a)	0.5	1.5	8	11	19	20	23	19	0
Gravel	31	- 64 + 16	10		1.5	2.5	8	27	35	12	15	3	0
		- 16 + 4	20		2.5	3.5	13	49	27	7	3	1	0
					3.5	4.5	12	43	23	5	9	8	0
		- 4 + 1	15		4.5	5.5	10	35	33	8	9	5	0
Sand	60	- 1 + ¼	21		5.5	6.5	15	32	22	10	15	6	0
		- ¼ + 1/16	24		6.5	7.5	7	26	26	15	17	9	0†
					7.5	8.5	10	45	31	6	7	1	0†
Fines	9	- 1/16	9		Mean		11	34	27	10	12	6	0
				(b)	17.1	18.1	6	5	9	25	32	23	0†
					18.1	19.1	6	6	15	28	25	20	0†
					19.1	20.1	5	7	14	26	25	5	18†
					20.1	20.9	9	8	7	18	31	27	0†
					Mean		6	6	11	25	28	19	5

NS 64 SE 10 6799 4180 Hill Farm, Avondale Block F_2

Surface level +194.3 m (+637 ft)
Water not struck
Shell, 250 mm diameter
February 1976

Waste 4.2 m
Bedrock 0.1 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Clay, red-brown with rare pebbles	0.7	0.7
Boulder clay	Clay, sandy, red-brown, with basalt clasts	2.9	3.6
	Clay, compact, blue-grey, with basalt clasts	0.6	4.2
Carboniferous (Calciferous Sandstone Measures)	Basalt, vesicular, porphyritic, blue-grey	0.1+	4.3

NS 64 SE 11 6711 4095 Bloomsholm Farm, Avondale Block F_2

Surface level +206.1 m (+676 ft)
Water not struck
Shell, 250 mm diameter
February 1976

Waste 5.1 m
Bedrock 0.2 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Soil, red clay	0.3	0.3
Boulder clay	Clay, sandy, mottled at top, red-brown, with angular clasts of basalt and sandstone	2.2	2.5
	Clay, stiff, grey, with subrounded clasts of green and grey basalts and yellow sandstone	2.6	5.1
Carboniferous (Calciferous Sandstone Measures)	Basalt, amygdaloidal, purplish green	0.2+	5.3

NS 64 SE 12 6853 4218 Netherholm Farm, Avondale Block F_2

Surface level +186.3 m (+611 ft)
Ground water level +183.8 m
Shell 250 mm diameter
February 1976

Waste 8.7 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Soil	0.5	0.5
Boulder clay	Clay, sandy, reddish brown, with sub-rounded clasts of basalt, sandstone and rare quartz	5.3	5.8
	Clay, sandy, silty, mid grey-brown, becoming dark brown with reddish tinge and stiff at base, with clasts of basalt and cream sandstone	2.9+	8.7
	Borehole abandoned due to rock obstruction		

NS 64 SE 13 6895 4148 Cauldcoats Farm, Avondale Block F_2

Surface level +216.1 m (709 ft)
Water not struck
Shell, 250 mm diameter
February 1976

Waste 0.7 m
Bedrock <0.1 m

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Soil, red clay with subrounded basalt clasts	0.7	0.7
Carboniferous (Calciferous Sandstone Measures)	Basalt, fine grained, grey, splintery	<0.1	0.7

NS 64 SE 14 | 6807 4048 | Redding Farm, Avondale | Block F_2

Surface level +214.5 m (704 ft)
Ground water level +213.2 m
Shell, 250 mm and 200 mm diameter
February 1976

Waste 10.0 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Clay, sandy, red	0.3	0.3
Boulder clay	Clay, red-brown, with clasts of grey basalt	0.9	1.2
	Clay, compact, very stiff below 5.0 m, dark grey, with clasts of basalt and red sandstone	8.8+	10.0
	Borehole abandoned due to rock obstruction		

NS 64 SE 15 | 6888 4037 | North Kirkwood Farm, Avondale | Block F_2

Surface level +234.1 m (+768 ft)
Water not struck
Shell 250 mm diameter
February 1976

Waste 4.2 m
Bedrock <0.1 m

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Soil, sandy clay, pebbly	0.3	0.3
Boulder clay	Clay, sandy, red, with rounded clasts of basalt, red sandstone and some quartz	3.9	4.2
Carboniferous (Calciferous Sandstone Measures)	Basalt, fine grained, greyish blue	<0.1	4.2

NS 64 SE 16 6971 4241 Townhead of Priestgill, Avondale Block F_2

Surface level +194.8 m (639 ft)
Water not struck
Shell 250 mm diameter
February 1976

Waste 2.2 m
Bedrock 0.3 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Clay, sandy, red, pebbly	0.3	0.3
Boulder clay	Clay, sandy, compact, red, with clasts of grey basalt, red acid igneous rocks, and red micaceous sandstone	1.9	2.2
Carboniferous (Calciferous Sandstone Measures)	Basalt, fine grained, weathered at top, dark grey	0.3+	2.5

NS 64 SE 17 6968 4136 Westhouse Farm, Avondale Block F_2

Surface level +215.4 m (+707 ft)
Water not struck
Shell 250 mm diameter
February 1976

Waste 0.6 m
Bedrock <0.1 m

LOG

Geological Classification	Lithology	Thickness m	Depth m
	Soil, clayey, pebbly	0.6	0.6
Carboniferous (Calciferous Sandstone Measures)	Basalt, fine grained, dark grey-blue	<0.1	0.6

APPENDIX G: PETROGRAPHICAL EXAMINATION OF THE +16 MM FRACTION OF THE GRAVELS

G. H. Collins (Petrology Unit)

INTRODUCTION

The +16 mm fraction of glacial sand and gravel samples from five boreholes was examined petrographically in order to determine the types and proportions of rock present. The borehole sites are indicated on Figure 3.

METHOD OF INVESTIGATION

Bulk samples of sand and gravel collected from boreholes (see Appendix A) were sent to commercial laboratories where a representative portion, obtained by coning and quartering, was sieve-graded and the gravel component reserved for subsequent examination by the Institute. The +16 mm fraction was weighed and each constituent rock type determined by macroscopic examination, though in some instances identification is based on microscopic inspection of rock crushes and thin sections. Each rock type was assigned to its Trade Group as defined in British Standard 812. Although this classification was designed for the products of hard rock quarries it is considered useful to apply it to gravel deposits for the guidance of sand and gravel interests. Vein quartz is not included in this classification and whilst having similar properties to rocks of the Quartzite Group, it is of igneous origin and so in this study, it has been placed in a separate group within the igneous rock category. Minor quantities of ironstone and muddy siltstone were observed and placed in the Gritstone Group as they contain granular quartz.

The results which are presented in Tables 14 to 19 are given as the number of clasts and their weight per cent within each Trade Group. Data on rock within each Trade Group are not given, but the results are available for consultation at the appropriate office of the Institute. Samples for which physical test data have been obtained are marked (a) to (f).

NOTES ON THE TRADE GROUPS

Granite Group
This Group includes granodiorite and diorite. Samples from boreholes 53 NE 22 contained one large cobble of granodiorite, weight 1.1 kg, very similar to specimens in the Petrology Unit's collections from the Distinkhorn 'granite', which crops out less than two miles to the south of Darvel. Several of the rocks examined are extremely weathered.

Porphyry Group
Felsites and porphyries constitute this Group and are found in the numerous Lower Old Red Sandstone dykes which occur in central and southern Scotland, making precise determination of source virtually impossible.

Basalt Group
No attempt was made to distinguish between various types of basalt. In general, however, the basaltic lavas of the Clyde Plateau Basalts are the source of over 90 per cent of the material assigned to the Group. The remainder are basalts from plugs or dykes or both and include some 5 per cent of quartz-dolerite from Permo-Carboniferous dykes. One pebble of epidiorite was derived either from Highland rocks of Cowal or Callander, or from Lower Old Red Sandstone conglomerate. Many of the basaltic lava pebbles are extremely weathered. These were classified separately in the pebble count, and constitute 15.5 per cent of Basalt Group rocks. Such weathered rocks are bound to have a deleterious effect on the physical properties of the gravels, especially as the Basalt Group totals 63 per cent of all rocks encountered.

Gritstone Group
Old Red Sandstone and Carboniferous sandstones predominate. A small proportion of very friable sandstone is possibly derived from Permo-Triassic rocks. Conglomerate, siltstone and ironstone occur in subordinate amounts. The ironstone is derived probably from Lower Old Red Sandstone sediments.

Flint Group
Five small pebbles of chert were found in a basal sample from borehole 53 NE 22. They are most likely to have been locally derived probably from Old Red Sandstone deposits.

Quartzite Group
A small percentage of quartzite, derived either from the Highland Border Series or from Old Red Sandstone conglomerates, occurs in all samples examined.

Schist Group
Included in this group are schists and schistose grits, rocks encountered in small proportions in all boreholes. Their source is undoubtedly north and west of the Highland Boundary Fault, although they may have been derived secondarily from conglomerates of Old Red Sandstone age.

Limestone, Hornfels and Gabbro Groups
Rock belonging to these Groups was not found.

Table 14. Pebble count analyses given as number and weight per cent of the +16 mm fraction - summary (for locations see Fig. 3)

Borehole No.	PROJECT TOTALS		CLASSIFICATION INTO TRADE GROUPS PER BS 812																					
			IGNEOUS										SEDIMENTARY								METAMORPHIC			
	Total No. of pebbles	Total Weight of pebbles kg	Vein Quartz		Granite Group		Porphyry Group		Basalt Group		Total Igneous		Gritstone Group		Flint Group		Quartzite Group		Total Sedimentary		Schist Group		Total Metamorphic	
			No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %
53 NE 22	725	18.84	30	2.5	11	9.2	21	1.5	447	67.6	509	80.8	182	16.3	5	0.3	10	1.3	197	17.9	19	1.3	19	1.3
63 NW 72	111	1.34	11	8.8	2	1.5	4	1.9	64	54.9	81	67.1	24	26.2	-	-	1	0.5	25	26.7	5	6.2	5	6.2
63 NW 76	483	12.74	27	2.7	4	0.6	13	4.8	294	66.5	338	74.6	129	22.2	-	-	11	2.4	140	24.6	5	0.8	5	0.8
63 NW 61	764	23.77	50	4.0	2	2.5	10	1.8	536	68.7	598	77.0	146	21.9	-	-	7	0.5	153	22.4	13	0.6	13	0.6
63 NW 79	402	9.54	16	2.1	2	0.2	11	4.1	163	39.9	192	46.3	190	46.8	-	-	19	6.8	209	53.6	1	0.1	1	0.1
Total for all bores	2485	66.23	134	3.2	21	3.7	59	2.6	1504	63.5	1718	73.0	671	24.0	5	0.1	48	2.0	724	26.1	43	0.9	43	0.9

Table 15. Pebble count analyses given as number and weight per cent of the +16 mm fraction - borehole 53 NE 22 (for location see Fig. 3)

	53 NE 22		CLASSIFICATION INTO TRADE GROUPS PER BS 812																			
			IGNEOUS										SEDIMENTARY								METAMORPHIC			
	Depth in Borehole	Total No. of pebbles	Total Weight of pebbles (g)	Vein Quartz		Granite Group		Porphyry Group		Basalt Group		Total Igneous		Gritstone Group		Flint Group		Quartzite Group		Total Sedimentary		Schist Group		Total Metamorphic	
				No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %
	0.50 - 1.75 m	70	2970.1	-	-	5	52.3	2	0.7	18	12.5	25	65.5	42	28.8	-	-	3	5.7	45	34.5	-	-	-	-
(a)*	1.75 - 2.60 m	119	4078.9	3	1.0	-	-	11	3.5	58	73.3	72	77.8	47	22.2	-	-	-	-	47	22.2	-	-	-	-
	2.60 - 3.20 m	12	448.3	-	-	-	-	-	-	9	85.2	9	85.2	3	14.8	-	-	-	-	3	14.8	-	-	-	-
	3.20 - 4.30 m	12	173.1	-	-	-	-	-	-	10	91.7	10	91.7	2	8.3	-	-	-	-	2	8.3	-	-	-	-
	4.30 - 5.10 m	76	1852.8	5	1.9	-	-	2	0.8	48	82.9	55	85.6	18	12.4	-	-	-	-	18	12.4	3	2.2	3	2.2
	5.10 - 5.70 m	105	2804.3	6	3.0	1	1.1	-	-	78	86.3	85	90.4	20	9.5	-	-	-	-	20	9.5	-	-	-	-
	5.70 - 6.70 m	122	2933.1	7	2.7	1	1.4	3	2.1	97	87.3	108	93.5	10	5.1	-	-	3	1.1	13	6.2	1	7.9	1	7.9
	6.70 - 7.40 m	100	1105.3	3	1.7	2	3.0	2	1.0	64	68.1	71	73.8	19	15.4	-	-	3	3.6	22	19.0	7	7.0	7	7.0
	7.40 - 8.10 m	36	747.2	1	0.6	-	-	1	3.5	25	79.4	27	83.5	6	13.0	-	-	1	1.2	7	14.2	2	2.2	2	2.2
	8.10 - 9.00 m	73	1727.9	5	11.8	2	4.3	-	-	40	55.9	47	72.0	15	18.1	5	3.7	-	-	20	21.8	6	6.0	6	6.0
	Total for bore	725	18838	30	2.5	11	9.2	21	1.5	447	67.6	509	80.8	182	16.3	5	0.3	10	1.3	197	17.9	19	1.3	19	1.3

* Denotes sample for which physical test data exists

Table 16. Pebble count analyses given as number and weight per cent of the +16 mm fraction - borehole 63 NW 61 (for location see Fig. 3)

63 NW 61			CLASSIFICATION INTO TRADE GROUPS PER BS 812																			
			IGNEOUS										SEDIMENTARY								METAMORPHIC			
Depth in Borehole	Total No. of pebbles	Total Weight of pebbles (g)	Vein Quartz		Granite Group		Porphyry Group		Basalt Group		Total Igneous		Gritstone Group		Flint Group		Quartzite Group		Total Sedimentary		Schist Group		Total Metamorphic	
			No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %
0.60 - 1.60 m	88	2780.9	6	1.9	-	-	5	11.3	57	65.4	68	78.6	20	21.4	-	-	-	-	20	21.4	-	-	-	-
1.60 - 2.60 m	88	3997.1	3	0.9	1	14.5	1	0.3	58	72.6	63	88.3	25	11.7	-	-	-	-	25	11.7	-	-	-	-
2.60 - 3.60 m	107	3553.5	8	2.6	-	-	-	-	73	50.2	81	52.8	22	45.3	-	-	2	1.3	24	46.6	2	0.5	2	0.5
(b)* 3.60 - 4.60 m	144	3896.5	8	2.7	-	-	-	-	106	82.5	114	85.2	30	14.8	-	-	-	-	30	14.8	-	-	-	-
4.60 - 5.60 m	130	5139.2	10	4.5	-	-	2	1.1	94	67.2	106	72.8	15	24.6	-	-	5	1.2	20	25.8	4	1.4	4	1.4
5.60 - 6.80 m	88	1975.0	7	17.4	-	-	-	-	64	70.5	71	87.9	12	10.2	-	-	-	-	12	10.2	5	1.9	5	1.9
6.80 - 7.80 m	45	964.9	3	2.3	-	-	1	1.3	37	86.5	41	90.1	4	9.9	-	-	-	-	4	9.9	-	-	-	-
7.80 - 9.30 m	37	656.3	3	8.2	1	1.7	-	-	24	63.4	28	73.3	7	23.4	-	-	-	-	7	23.4	2	3.3	2	3.3
9.30 - 10.30 m	29	499.0	1	1.3	-	-	1	6.6	19	75.6	21	83.5	8	16.5	-	-	-	-	-	-	-	-	-	-
10.30 - 11.30 m	4	219.5	-	-	-	-	-	-	2	44.1	2	44.1	2	55.9	-	-	-	-	2	55.9	-	-	-	-
11.30 - 12.30 m	3	72.9	-	-	-	-	-	-	2	49.1	2	49.4	1	50.6	-	-	-	-	1	50.6	-	-	-	-
12.30 - 15.30 m	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15.30 - 16.70 m	1	6.1	1	100	-	-	-	-	-	-	1	100	-	-	-	-	-	-	-	-	-	-	-	-
16.70 - 22.00 m	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total for bore	764	23761	50	4.0	2	2.5	10	1.8	536	68.7	598	77.0	146	21.9	-	-	7	0.5	153	22.4	13	0.6	13	0.6

* Denotes sample for which physical test data exists

Table 17. Pebble count analyses given as number and weight per cent of the +16 mm fraction - borehole 63 NW 72 (for location see Fig. 3)

	63 NW 72			CLASSIFICATION INTO TRADE GROUPS PER BS 812																			
				IGNEOUS										SEDIMENTARY								METAMORPHIC			
	Depth in Borehole	Total No. of pebbles	Total Weight of pebbles (g)	Vein Quart		Granite Group		Porphyry Group		Basalt Group		Total Igneous		Gritstone Group		Flint Group		Quartzite Group		Total Sedimentary		Schist Group		Total Metamorphic	
				No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %
(c)*	0.50 - 1.70 m	72	860.5	11	13.6	2	2.4	2	1.4	41	60.0	56	77.4	12	13.6	-	-	-	-	12	13.6	4	8.9	4	8.9
	1.70 - 3.10 m	23	240.3	-	-	-	-	2	5.6	15	43.7	17	49.3	5	48.2	-	-	1	2.5	6	50.7	-	-	-	-
	3.10 - 4.10 m	5	44.5	-	-	-	-	-	-	3	56.2	3	56.2	2	43.8	-	-	-	-	2	43.8	-	-	-	-
	4.10 - 5.10 m	6	69.4	-	-	-	-	-	-	4	73.6	4	73.6	1	16.6	-	-	-	-	1	16.6	1	9.8	1	9.8
	5.10 - 6.10 m	3	108.7	-	-	-	-	-	-	1	32.7	1	32.7	2	67.3	-	-	-	-	2	67.3	-	-	-	-
	6.10 - 13.80 m	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	13.80 - 15.00 m	2	13.4	-	-	-	-	-	-	-	-	-	-	2	100	-	-	-	-	2	100	-	-	-	-
	15.00 - 17.00 m	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total for bore	111	1336.8	11	8.8	2	1.5	4	1.9	64	54.9	81	67.1	24	26.2	-	-	1	0.5	25	26.7	5	6.2	5	6.2

* Denotes sample for which physical test data exists

Table 18. Pebble count analyses given as number and weight per cent of the +16 mm fraction - borehole 63 NW 76 (for location see Fig. 3)

	63 NW 76		CLASSIFICATION INTO TRADE GROUPS PER BS 812																			
			IGNEOUS										SEDIMENTARY								METAMORPHIC			
Depth in Borehole	Total No. of pebbles	Total Weight of pebbles (g)	Vein Quartz		Granite Group		Porphyry Group		Basalt Group		Total Igneous		Gritstone Group		Flint Group		Quartzite Group		Total Sedimentary		Schist Group		Total Metamorphic	
			No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %
0.50 - 2.00 m	119	4812.7	7	1.5	-	-	4	8.3	73	72.8	84	82.6	33	16.2	-	-	-	-	33	16.2	2	1.1	2	1.1
2.00 - 3.20 m	198	5402.0	11	2.8	3	0.8	4	1.8	107	63.9	125	69.3	61	25.7	-	-	9	4.1	70	29.8	3	0.9	3	0.9
(d)* 3.20 - 4.00 m	61	1154.8	6	4.3	-	-	2	2.5	36	60.3	44	67.1	15	25.8	-	-	2	7.1	17	32.9	-	-	-	-
4.00 - 14.50 m	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14.50 - 16.30 m	15	284.8	-	-	1	11.8	-	-	9	29.4	10	41.2	5	58.7	-	-	-	-	5	58.7	-	-	-	-
16.30 - 17.30 m	8	110.5	-	-	-	-	-	-	5	58.6	5	58.6	3	41.4	-	-	-	-	3	41.4	-	-	-	-
17.30 - 18.30 m	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18.30 - 19.30 m	2	11.2	-	-	-	-	-	-	1	39.3	1	39.3	1	60.7	-	-	-	-	1	60.7	-	-	-	-
19.30 - 20.30 m	4	84.2	-	-	-	-	1	71.8	1	10.8	2	82.6	2	17.3	-	-	-	-	2	17.3	-	-	-	-
20.30 - 21.30 m	76	877.5	3	7.9	-	-	2	3.3	62	74.4	67	85.4	9	14.6	-	-	-	-	9	14.6	-	-	-	-
Total for bore	483	12738	27	2.7	4	0.6	13	4.8	294	66.5	338	74.6	129	22.2	-	-	11	2.4	140	24.6	5	0.8	5	0.8

* Denotes sample for which physical test data exists

Table 19. Pebble count analyses given as number and weight per cent of the +16 mm fraction - borehole 63 NW 79 (for location see Fig. 3)

	63 NW 79		CLASSIFICATION INTO TRADE GROUPS PER BS 812																					
			IGNEOUS										SEDIMENTARY								METAMORPHIC			
Depth in Borehole	Total No. of pebbles	Total Weight of pebbles (g)	Vein Quartz		Granite Group		Porphyry Group		Basalt Group		Total Igneous		Gritstone Group		Flint Group		Quartzite Group		Total Sedimentary		Schist Group		Total Metamorphic	
			No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %
0.30 - 1.20 m	40	668.0	1	0.8	-	-	2	2.4	15	21.8	18	25.0	20	72.0	-	-	2	3.0	22	75.0	-	-	-	-
1.20 - 2.20 m	18	217.9	1	5.3	2	11.2	-	-	10	65.7	13	82.2	5	17.8	-	-	-	-	5	17.8	-	-	-	-
2.20 - 3.00 m	15	236.4	-	-	-	-	-	-	7	26.3	7	26.3	8	73.7	-	-	-	-	8	73.7	-	-	-	-
(e)* 3.00 - 4.00 m	90	2334.7	5	3.2	-	-	1	1.7	29	32.1	35	37.0	52	52.7	-	-	3	10.3	55	63.0	-	-	-	-
4.00 - 5.00 m	24	489.0	2	3.6	-	-	-	-	12	76.4	14	80.0	9	18.1	-	-	-	-	9	18.1	1	1.9	1	1.9
5.00 - 6.00 m	2	19.5	-	-	-	-	-	-	1	33.3	1	33.3	1	66.7	-	-	-	-	1	66.7	-	-	-	-
6.00 - 7.00 m	1	57.4	-	-	-	-	1	100	-	-	1	100	-	-	-	-	-	-	-	-	-	-	-	-
7.00 - 8.00 m	26	909.3	-	-	-	-	3	13.7	12	11.9	15	25.6	10	73.4	-	-	1	1.0	11	74.4	-	-	-	-
8.00 - 9.00 m	3	24.1	1	25.7	-	-	-	-	1	29.5	2	55.2	1	44.8	-	-	-	-	1	44.8	-	-	-	-
9.00 - 10.00 m	31	658.0	1	2.4	-	-	-	-	18	54.5	19	56.9	6	9.6	-	-	6	33.5	12	43.1	-	-	-	-
10.00 - 11.00 m	2	262.4	-	-	-	-	-	-	2	100	2	100	-	-	-	-	-	-	-	-	-	-	-	-
11.00 - 12.00 m	11	239.2	1	3.0	-	-	-	-	7	87.2	8	90.2	2	4.5	-	-	1	5.3	3	9.8	-	-	-	-
12.00 - 13.00 m	12	210.6	-	-	-	-	1	11.6	4	64.1	5	75.7	7	24.2	-	-	-	-	7	24.2	-	-	-	-
13.00 - 14.00 m	6	93.4	-	-	-	-	-	-	1	12.5	1	12.5	5	87.5	-	-	-	-	5	87.5	-	-	-	-

Table 19 Cont'd

	Depth in Borehole	Total No. of pebbles	Total Weight of pebbles (g)	CLASSIFICATION INTO TRADE GROUPS PER BS 812																			
				IGNEOUS										SEDIMENTARY								METAMORPHIC			
				Vein Quartz		Granite Group		Porphyry Group		Basalt Group		Total Igneous		Gritstone Group		Flint Group		Quartzite Group		Total Sedimentary		Schist Group		Total Metamorphic	
				No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %	No. of pebbles	Wt %
	63 NW 79																						
(f)*	14.00 - 15.00 m	44	1195.6	-	-	-	-	-	-	7	26.0	7	26.0	32	63.9	-	-	5	10.1	37	74.0	-	-	-	-
	15.00 - 15.40 m	42	1294.6	3	3.7	-	-	-	-	16	40.8	19	44.5	22	54.1	-	-	1	1.3	23	55.4	-	-	-	-
	15.40 - 16.50 m	21	504.3	-	-	-	-	2	22.0	9	57.2	11	79.2	10	20.7	-	-	-	-	10	20.7	-	-	-	-
	16.50 - 17.70 m	4	31.3	-	-	-	-	-	-	4	100	4	100	-	-	-	-	-	-	-	-	-	-	-	-
	17.70 - 18.20 m	3	23.5	-	-	-	-	1	31.1	2	68.9	3	100	-	-	-	-	-	-	-	-	-	-	-	-
	18.20 - 19.30 m	2	10.0	-	-	-	-	-	-	2	100	2	100	-	-	-	-	-	-	-	-	-	-	-	-
	19.30 - 20.30 m	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	20.30 - 21.30 m	1	4.2	-	-	-	-	-	-	1	100	1	100	-	-	-	-	-	-	-	-	-	-	-	-
	21.30 - 22.30 m	4	54.8	1	14.1	-	-	-	-	3	85.9	4	100	-	-	-	-	-	-	-	-	-	-	-	-
	Total for bore	402	9538.2	16	2.1	2	0.2	11	4.1	163	39.9	192	46.3	190	46.8	-	-	19	6.8	209	53.6	1	0.1	1	0.1

* Denotes samples for which physical test data exists

CONCLUSIONS

The proportion of weathered rock noted in the Basalt and Granite Groups, and friable sandstone from the Gritstone Group are reflected in the rather high aggregate impact values obtained (Table 1). However, much of the rotten material might be eliminated in commercial processing.

Considering the high proportion of basaltic rocks in the gravels the specific gravity results are rather low, indicating that much of the basalt is altered.

Without microscopic examination of every pebble within the Basalt Group, it is not possible to assess the degree of alteration of the ferromagnesian minerals to clay minerals of the montmorillonite and/or chlorite groups, which are susceptible to volume changes in the presence of water. Consequently the high proportion of Basalt Group rocks (63 per cent) may account for the relatively high shrinkage characteristics of concrete, as shown in Table 1.

APPENDIX H: LIST OF WORKINGS

In 1977 three sand and gravel pits, listed below, were known to be operational. All areas which are known to have been worked are shown on the map accompanying the report. To date all sand and gravel extraction in the district has been confined to ground lying above the water table.

Site	Grid reference	Operator	Deposit worked
Loudoun Hill	613 374	Tilling Construction Services Ltd.	Glacial sand and gravel
Snabe	645 390	J. M. Filshie and Sons	Glacial sand and gravel
South Torfoot	637 380	Shanks and McEwan (Contractors) Ltd.	Glacial sand and gravel

APPENDIX I: CONVERSION TABLE, METRES TO FEET (TO NEAREST 0.5 FT)

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

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INSTITUTE OF GEOLOGICAL SCIENCES

INDUSTRIAL MINERALS ASSESSMENT UNIT

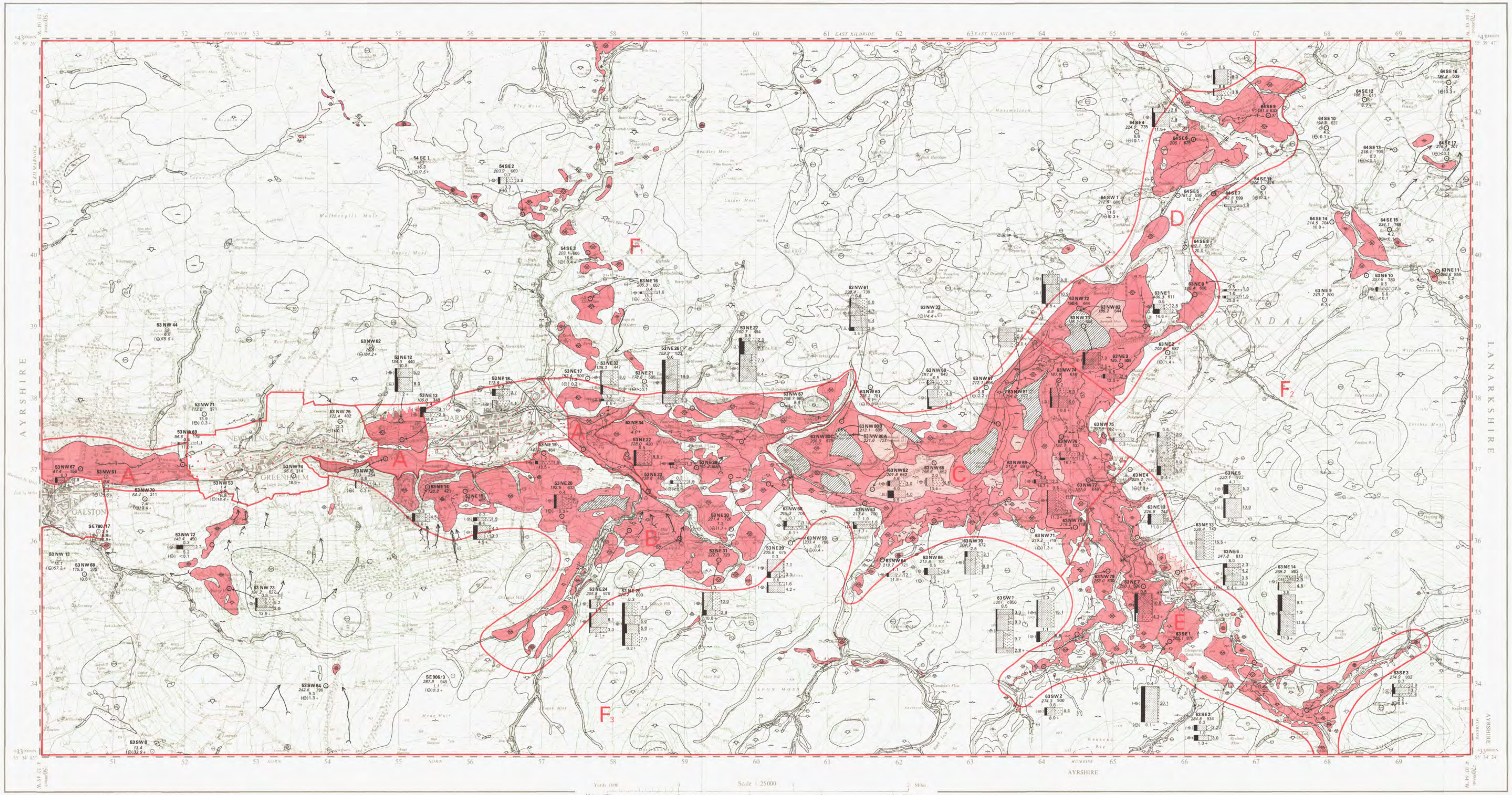
THE SAND AND GRAVEL RESOURCES OF THE DARVEL AREA, STRATHCLYDE

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

35

ORDNANCE SURVEY
PARTS OF SHEETS NS 53,54,63 & 64
PROVISIONAL EDITION

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



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

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

Original geological survey on the six-inch scale by A.Geikie, J.Geikie and B.N.Peach, 1870-72.
Revised by E.M.Anderson, E.B.Bailey, R.G.Carruthers, C.H.Dinham, A.G.MacGregor, J.Phemister, J.E.Richey and G.Ross between 1912 and 1925.
Partial re-survey by P.Stone and A.D.McAdam in 1976. G.I.Lumsden, District Geologist.

Sand and Gravel Survey by A.M.Aitken and A.A.McMillan in 1975-76, under the supervision of E.F.P.Nickless.
R.G.Thurrell, Head, Industrial Minerals Assessment Unit.

1:25 000 Sand and Gravel Resource Sheet published 1978.
Austin W. Woodland, C.B.E., Director, Institute of Geological Sciences, incorporating the Geological Survey of Great Britain, the Museum of Practical Geology and Overseas Geological Surveys.

1100/78

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

Compiled from 6" sheets last fully revised 1856-1913. Other partial systematic revision 1938-1939 has been incorporated.

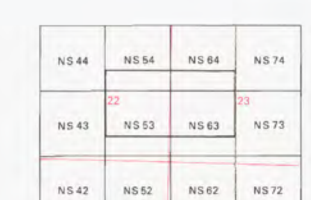


Diagram showing the relation of the National Grid 1:25,000 sheets with the One-inch Geological sheets 22 and 23

EXPLANATION OF SYMBOLS AND ABBREVIATIONS

Landslip

DRIFT
RECENT AND PLEISTOCENE

- **Peat** P-1
- **Alluvium**-silt, sand and gravel deposited in present and former river valleys, often forming a series of terraces A-23
- **Alluvial cone** AC-1
- **Glacial lake deposits** -laminated fine sand, silt and clay GL-2
- **Glacial sand and gravel** - mainly well sorted sands and poorly sorted gravels GS-22
- **Boulder clay**-reddish brown to grey stiff stony clay, silty in places BC-12

SOLID

Bedrock, at or near surface (undifferentiated)

Over the north part of the resource sheet, bedrock mainly comprises Carboniferous basaltic lavas and intrusives with subordinate sandstone. Except for Distinkhorn which is formed of granodiorite, the remainder of the area is occupied either by Old Red Sandstone volcanics and sandstones or Silurian sandstones, siltstones and shales.

Made ground -waste and/or natural earth materials deposited on original ground surface MG-3

Worked ground WG-1

BOUNDARY LINES

- Geological boundary, Drift
- Inferred boundary between recognised categories of deposits
- Resource Block boundary
- Back feature of glacial or river terrace, downward slope in direction of arrowhead
- Glacial drainage channel showing direction of flow

BOREHOLE DATA

SITE LOCATIONS

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

I.M.A.U. BOREHOLES

Borehole Registration Number → 63 SE 3
274.9 902 ← Surface level in metres and feet above O.D. (Newlyn)
Borehole Site
0.7 ← Overburden
Geological Classification
2.0 / 3.7 / 1.6 ← Mineral (sand and gravel)
Grading Diagram
2.2 ← Waste
0.6+ ← Bedrock

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 figures in *italics* are the metric conversions of measurements recorded in feet.
(iv) The Geological Classification is given only for mineral and bedrock.

Borehole Registration Number

Each I.M.A.U. borehole is identified by a Registration Number, e.g. 63 SE 3. The first numbers and letters refer to the quarter sheet and the final figures to the I.G.S. serial numbers for that quarter. The unique designation for borehole 63 SE 3 is NS 63 SE 3.

Grading Diagrams

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

Sand (+1/16-4mm)
Fines (-1/16mm) Gravel (+4mm)

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

The widths of the divisions show the proportions of **Fines**, **Sand** and **Gravel** but small amounts 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, except for I.G.S. Site Exploration records. For example, SE 790/17 signifies borehole 17 of Site Exploration file No. 790 held by I.G.S. Records Department.

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 * Reference number and, where space permits, details of thicknessess are shown.

CATEGORIES OF DEPOSITS

- **Exposed mineral** CAT-E6
- **Continuous or almost continuous spreads of mineral beneath overburden** CAT-C1
- **Sand and gravel not assessed (exposed and/or beneath cover)** CAT-N3
- **Sand and gravel absent or not potentially workable** CAT-A2

RESOURCE BLOCKS

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

Detailed records may be consulted at the Edinburgh office of the Institute on application to the Officer-in-charge, Industrial Minerals Assessment Unit, Institute of Geological Sciences, Murchison House, West Mains Road, Edinburgh EH9 3LA.

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