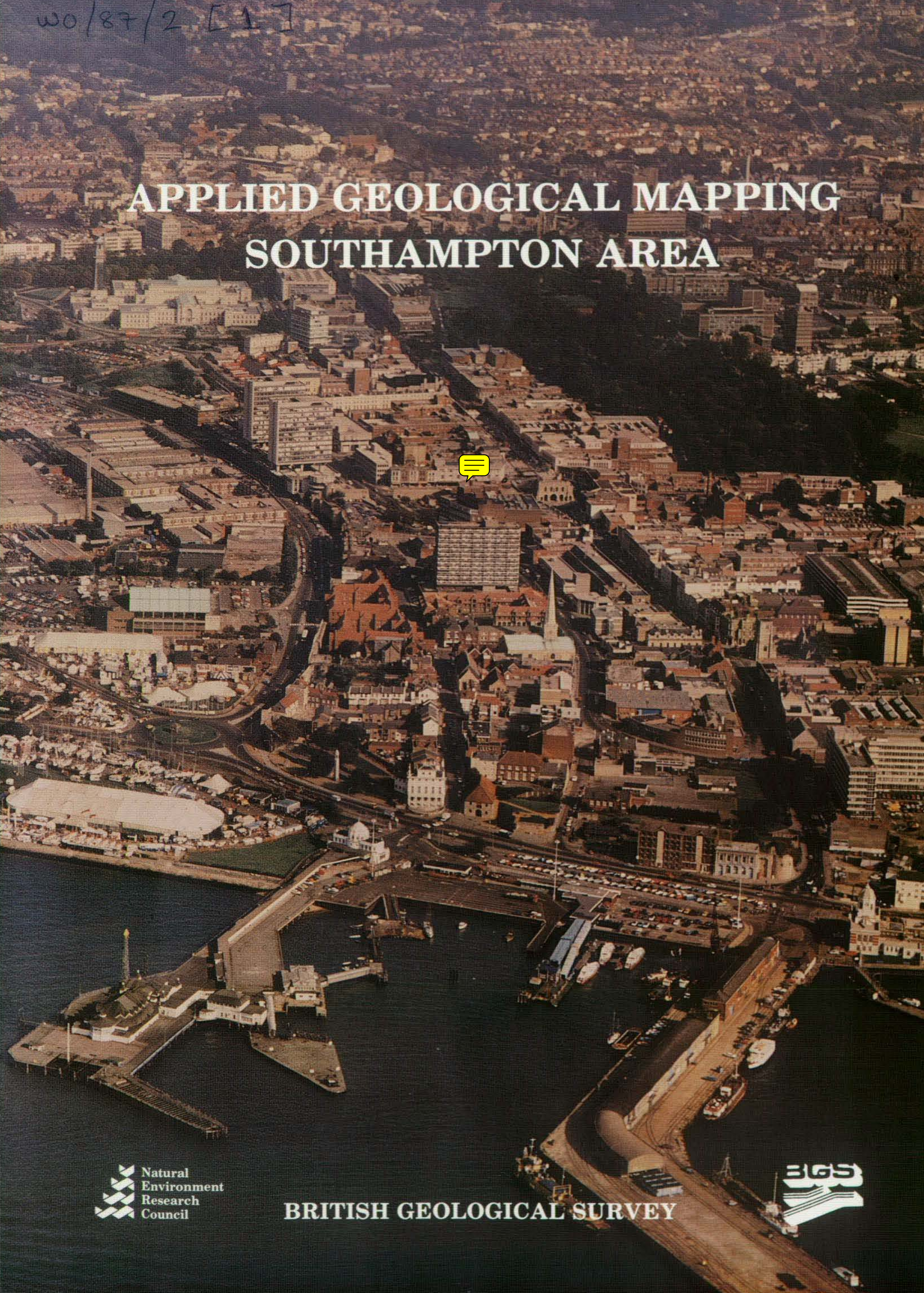
APPLIED GEOLOGICAL MAPPING SOUTHAMPTON AREA



Natural Environment Research Council

BRITISH GEOLOGICAL SURVEY

Cover photograph

We see Southampton city centre from the air, looking northwards over the Royal Pier and Mayflower Park (where a Boat show is taking place) in the foreground. The low-lying area in the left centre, occupied mainly by industrial buildings, is formed of reclaimed land over Estuarine Alluvium deposits. Most of the rest of the city is built on River Terrace Deposits overlying formations of the Bracklesham Group.

MAPS OF
MINERAL RESOURCES
(E1-E7, F)

VOLUME 6

BGS Research Report ICSO/87/2

Natural Environment Research Council
BRITISH GEOLOGICAL SURVEY

APPLIED GEOLOGICAL MAPPING SOUTHAMPTON AREA

Area covered by
1:50 000 Geological sheet No. 315 (Southampton)
Parts of OS 1:10 000 sheets SU20, SU21, SU22, SU30, SU31, SU32, SU40, SU41, SU42, SU50, SU51 and SU52

VOLUME 6: MAPS OF MINERAL RESOURCES

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Production of this report was supported by the Department of the Environment but the views expressed in it are not necessarily those of the Department

Bibliographic reference
EDWARDS, R.A., SCRIVENER, R.C. and FORSTER, A. 1987.
Applied geological mapping: Southampton area.
Research Report of the British Geological Survey, No ICSO/87/2, vol 6.

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EXETER BRITISH GEOLOGICAL SURVEY 1987

Notes to the user

There is considerable variation in the quality and reliability of the source data used to compile this report and the accompanying set of applied geology maps, as well as a great disparity in the density of site investigation data within the study area. Therefore, the accuracy and reliability of the interpreted information reflects that of the source data. However, emphasis has been placed throughout on the most reliable data, particularly those derived from authoritative sources such as geotechnical engineers and geologists.

Thus the report and maps are to be regarded as the *best interpretation of the information available at the time of compilation. They should be used for preliminary studies only and are not intended as a substitute for on-site investigations or detailed local searches.* The responsibility for assuring that geological, geotechnical and mineral and water resource data for any given site are as indicated in the maps and in the figures and text of this report must remain solely that of the user.

The possible occurrence of undetected anomalous site conditions should always be anticipated. The indicated occurrences of mineral deposits do not necessarily imply an economic resource. The possible presence of unmapped variable thicknesses of superficial deposits and Made Ground, particularly within the urban area of Southampton, should also be taken into account in any planning procedures.

There is no substitute for the knowledge provided by a detailed site investigation that takes into consideration the extent, nature and location of a proposed development. Therefore the report and maps are intended a) to give guidance on when to seek specialist advice and b) to aid developers in formulating effective investigations.

No information made available after the end of 1986 has been taken into account in this report.

All National Grid references in the report lie within the 100km square SU. Grid references are given to either eight figures (accurate to within 10m), or six figures for more extensive locations.

Data used in preparing this report and associated maps is lodged at the Exeter office of the British Geological Survey. Any enquiries concerning these documents should be directed to that office. Enquiries concerning the computer techniques or methodology should be directed to the Edinburgh or Keyworth office of the Survey. Enquiries about purchase of the report or maps should be directed to the National Geosciences Data Centre, British Geological Survey, Keyworth, Nottingham NG12 5GG.

DESCRIPTION OF THE APPLIED GEOLOGY MAPS

Sand and gravel resources (Maps E1-E6)

The maps showing sand and gravel resources comprise six sheets at the 1:25 000 scale. Two types of resource are shown on the face of the maps, namely, areas underlain by River Terrace Deposits and Alluvium, which are important sources of flint gravel, and areas underlain by solid formations consisting mainly of sand. The gravel deposits are ornamented to distinguish resources at, or close to, surface, including the Older River Gravels, River Terrace Deposits and Alluvium of small streams, and resources which are buried beneath the silty or clayey drift deposits, mainly the Alluvium of the major rivers. The deposits considered as a sand resource include the sand units of the Reading Formation, the Whitecliff Sand, the Earnley Sand and the Becton Sand. Where the sand resources are buried by solid or drift deposits they are not shown on the face of the maps as evidence suggests that they are not likely to be economic. Areas of former and active sand and gravel working are identified on the maps.

Descriptions of the various solid and drift formations are given in the Appendix. These descriptions and Map sets A and B should be examined in conjunction with the sand and gravel resource sheet.

The River Terrace Deposits and Alluvial Gravels provide three type of product namely:

Fill material ("hoggin")
Concreting aggregate
Washed sand and gravel

The Older River Gravels ("Plateau Gravel" of earlier accounts) yield clay-bound flint gravel that is suitable for use as fill and for the surfacing of rough tracks. The lower River Terrace Deposits and tracts of Alluvium include beds of gravel which, with little treatment, yield a suitable sand and gravel mix for concrete aggregate, or may be washed to provide clean gravel and various grades of sand. The grading characteristics of River Terrace and alluvial gravels are summarized in Figures 6 and 7 respectively. The grading envelopes of Figure 6 is for 170 samples and that of Figure 7 for 45 samples. These envelopes show that the gravels range from relatively clean, moderately well-sorted medium and coarse gravels to poorly sorted gravel with 10 to 15 percent fines.

The solid formations are mainly worked for building sand, though a small production of foundry sand is maintained in the project area. In general, there is a distinction between "clean" sand with a low fines content and "soft" sands which are generally finer grained and with perhaps 10 to 15 per cent of silt and clay. The latter class is much used in rendering as the clay content aids the adhesion of the mortar to its substrate. Clean sands are used in bricklaying, as an addition to concrete mixes and in asphalt.

Of the sandy solid formations shown on the thematic maps, only the sand units in the Reading Formation and the Whitecliff Sand are worked at present. The sand units of the Reading Formation yield, in the main, grey medium- to coarse-grained sands with subordinate pebble beds. In places, the sands are fine and have a clay content. The Whitecliff Sand comprises yellow to buff-coloured, fine- to coarse-grained clean sands. It is locally pebbly, and clay pellets are present in places. A grading envelope derived from 20 samples of Whitecliff Sand is shown in Figure 8 and shows the generally well-sorted nature of the formation and its lack of fines. The Earnley Sand is worked for foundry sand at the present day, in a small pit near Hound [474 087], and for this reason is shown as a resource on the map. It comprises green to greyish green glauconitic silty sands, much disturbed by the activities of burrowing creatures at the time of deposition, and with a substantial fossil shell content in places. Although locally the Earnley Sand is relatively clean and well-sorted, the presence of silt and of shelly material, together with bands of clay render the formation relatively unattractive to the extractive industry. The fines content approaches 30 per cent in some of the samples analysed.

The Becton Sand is not worked in the project area at present, but was formerly worked around Lyndhurst [299 082] and in the Fawley [458 032] district. It comprises pale yellow to grey well-sorted very fine-grained sand with, in places, thin layers of sandy clay. The grain size and fines content have restricted the use of this material for general purposes.

Of the solid formations not included on the map some, notably the Wittering Formation and the Marsh Farm Formation, locally include beds of relatively clean sand. Grading envelopes for these formations, based on 50 and 55 samples respectively are shown in Figures 10 and 11.

Table 2. Grading criteria used to define sand and gravel categories

Lithology	Grading
"Gravel"	more than 40% retained on 4mm sieve less than 30% passing 0.125mm sieve
"Gravel/sand" (sand medium- to coarse-grained)	10 to 40% retained on 4mm sieve less than 40% passing 0.25mm sieve less than 30% passing 0.125mm sieve
"Gravel/sand" (sand fine- to medium-grained)	10 to 40% retained on 4mm sieve more than 40% passing 0.25mm sieve less than 30% passing 0.125mm sieve
"Sand" (medium- to coarse-grained)	less than 10% retained on 4mm sieve less than 40% passing 0.25mm sieve less than 30% passing 0.125mm sieve
"Sand" (fine- to medium-grained)	less than 10% retained on 4mm sieve more than 40% passing 0.25mm sieve less than 30% passing 0.125mm sieve
"Waste"	more than 30% passing 0.125mm sieve

Sand and gravel end-use analysis, Lymington and Beaulieu area (Map E7)

Prior to the present study the Industrial Minerals Assessment Unit (IMAU) of BGS carried out an assessment of the sand and gravel resources of the area around Lymington and Beaulieu (Mathers, 1982). The area covered by that survey overlaps the southern margin of the current project area and also includes the major industrial area around Fawley [458 032], only part of which lies within the Southampton project area, but which is of particular planning interest. Because of this interest and the availability of the detailed IMAU data it was decided to produce an end-use assessment map covering the same area as the eastern sheet of the Lymington and Beaulieu assessment, that is between eastings SU 32 and SU 48 and northings SZ 95 and SU 07. This extends considerably further south than the main Southampton project area.

The basic numerical data comprise grading analyses of bulk samples of sand and gravel. Samples were collected at regular intervals for all sand and gravel drilled and the grading results, which were obtained mostly from commercial laboratories, were entered on the computer. These data were used to generate the graphic logs displayed on the published resource maps (Mathers, 1982) and indicate both the thickness and mean grading of lithologically distinct units of sand and gravel.

For the present study the grading data have been analysed by computer in two separate complementary ways, both methods being designed to illustrate potential end-usage. The first method produces a summary graphic log of deposit lithology using the cumulative mean gradings for each distinct unit of sand and gravel. The second method uses the gradings of individual samples and generates spider diagrams which portray the potential commercial usage of the total thickness of sand and gravel proved at each sample point.

The presentation of the summary graphic logs is similar to the borehole arrays shown on the published resource maps in that the height of the grading box is proportional to the thickness of a sand and gravel unit. However, whereas the grading boxes on the published resource maps are divided vertically to show relative proportions of fines, sand and gravel, those on the summary maps are ornamented simply to portray five grading categories. Thicknesses only are given for overburden and for deposits classified as waste, either on account of the grading of the material or because the overburden to mineral ratio is greater than 3:1. Because of the more restrictive criteria used on the summary resource maps, some of the material shown on the published resource map as potentially workable, has been reclassified as waste.

The method of analysis allocates each lithologically distinct unit within a sand and gravel deposit to one of six categories. The grading criteria used to define these categories are shown in Table 2, and are based on the results of a sedimentological study by Martin (1981). The categories relate broadly to Martin's lithological facies and take account of the various British Standard specifications for aggregates sold commercially.

Any deposits containing more than 30% passing 0.125mm is considered here as waste because nearly all the British Standard specifications for aggregates rule out such material. As a result of this criterion deposits with more than 30% passing 0.125mm and containing a significant amount of gravel-grade material will have been discounted, although they may have some economic potential: some silty, fine-grained sands might also find specialised markets. Such deposits would be shown on the published resource maps where sand and gravel containing up to 40% material passing 0.063mm (fines) is regarded as potentially workable.

The spider diagrams at each sample point for which grading data are available, are intended to allow the user rapidly to judge the relative proportion of material best suited to specific end-uses. Less specifically, they also show whether deposits at a sample point are predominantly gravelly or sandy.

This approach to the analysis of the grading is strictly in terms of end-use. A search of British Standards and other codes of practice revealed that currently there are forty-three grading specifications for aggregates. As the sieve sizes specified in the standards generally differ from those used in the assessment surveys, mathematical interpolation of the grading data has been necessary. These inferred data were compared, sample by sample, with each of the forty-three end-use grading specifications using a modified version of a computer program written for the Manitoba Geological Survey (program SG02).

The sand (0.075 to 3.35mm) and gravel (coarser than 3.35mm) components of each sample are considered separately in an attempt to simulate the screening processes that are used at a quarry. Both the sand and gravel components are recalculated to 100% with the proviso that when considering the gravel component, the sample as a whole must contain no more than 80 per cent sand and when considering the sand component the sample as a whole should have no more than 60 per cent gravel; if these conditions are not met the grading of the relevant component is set arbitrarily to zero. These cut-offs were chosen by trial-and-error to reflect the approximate minimum component percentages that it is considered are required prior to processing for either the sand or gravel end uses. The results of the separate analyses of the sand and gravel components of each sample are then recombined to given an overall analysis of the sample.

A second screening is simulated by ignoring material coarser than the coarsest sieve quoted for each end-use specification; only the material passing the appropriate sieve is considered and this part of the grading is then recalculated to 100%. If more than 80 per cent, in the case of the gravel component, or 60 per cent in the case of sand, is retained on this coarsest sieve then the sample is considered to be not suitable for the particular end-use. No account is taken of the possible crushing of over-size material.

When the grading of a sample falls within the grading envelope specified for a particular end-use, the sample is considered to be suitable for that end-use. For any sieve size for which the percentage weight retained lies outside the limits stipulated in that specification, the difference between the actual figure and the nearer of the upper or lower limit of the permitted grading envelope is calculated as a residual. These residuals are summed for each sieve-size specified for a particular end-use and, if no greater than thirty, the sample is regarded as marginal. In order to simulate washing, samples with total residuals of up to forty are also considered as marginal, if the specification stipulates 0 per cent passing the 0.075mm-sieve and at least ten points of the total residual value is accounted for by the 0.075mm-sieve. All samples with total residuals greater than those stated above are regarded as not suitable for the particular end-use.

The forty-three end-uses fall naturally into eight major groupings: in order of increasing fineness they are roadstone, coarse asphalt aggregate, coarse concrete aggregate, all-in aggregate, sub-base/roadstone, fine concrete aggregate, plastering/ mortar sand and fine asphalt aggregate. For each sample a suitability integer value, 0, 1 or 2 is allocated to each of the forty-three end-uses depending on whether it is classed as not suitable, marginal or suitable, respectively. These integer values are summed for each of the eight end-use groups, after weighting to account for sample thickness and the different number of end-uses within each group, and then summed again for all samples from the same borehole. The end-use potential index for each end-use group at each sample point is the product of the sum of the integer values (described above) and the thickness. The maximum value of this index for any one end-use group for a 25m deep borehole is therefore fifty, that is 25x2.

The end-use potential is shown by computer-drawn, eight-legged spider diagrams, centred at each sample point. Each leg represents one end-use group, its length being proportional to the end-use potential index for that end-use. The roadstone is represented by the upwards vertical leg, the other legs radiating at increments of 45° in a clockwise direction in order of increasing fineness. The spider diagrams must be interpreted with caution and should be read in conjunction with the summary graphic logs, in order that the likely position within a borehole of material meeting the specifications of particular end-use groupings can be judged. For example, the spider diagram might show the material as a whole at a sample point to be an all-in aggregate, whereas the graphic log might reveal a unit of gravel overlying one of fine- to medium- grained sand. From this, the position within the sequence of material meeting particular end-use group specifications can be determined.

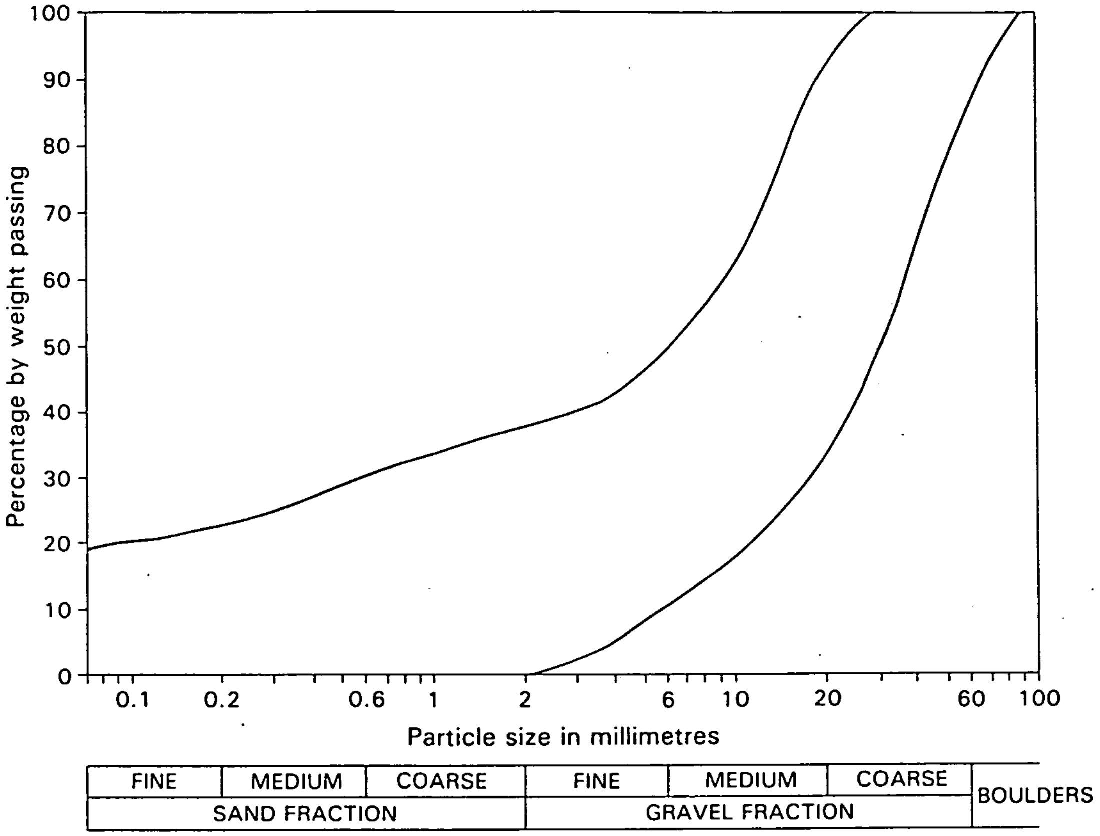

Figure 6. Grading 'envelope' for river terrace deposit gravel (170 samples)

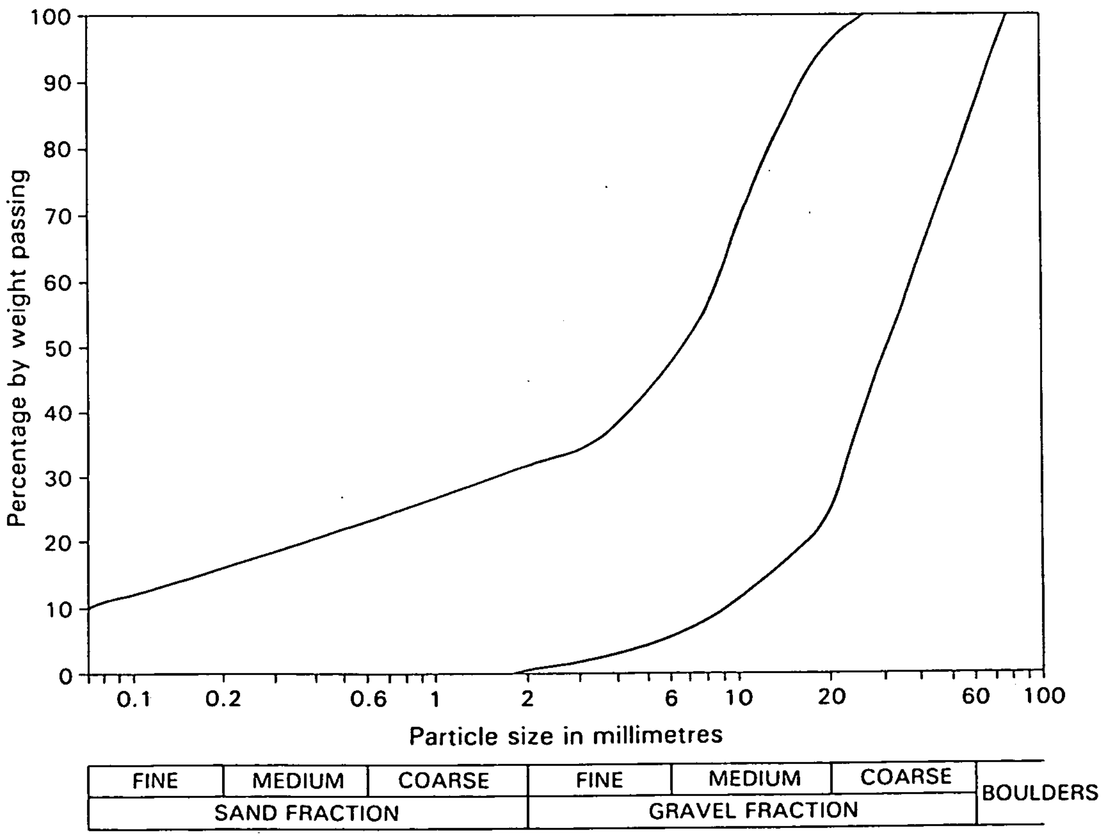

Figure 7. Grading 'envelope' for alluvium (45 samples)

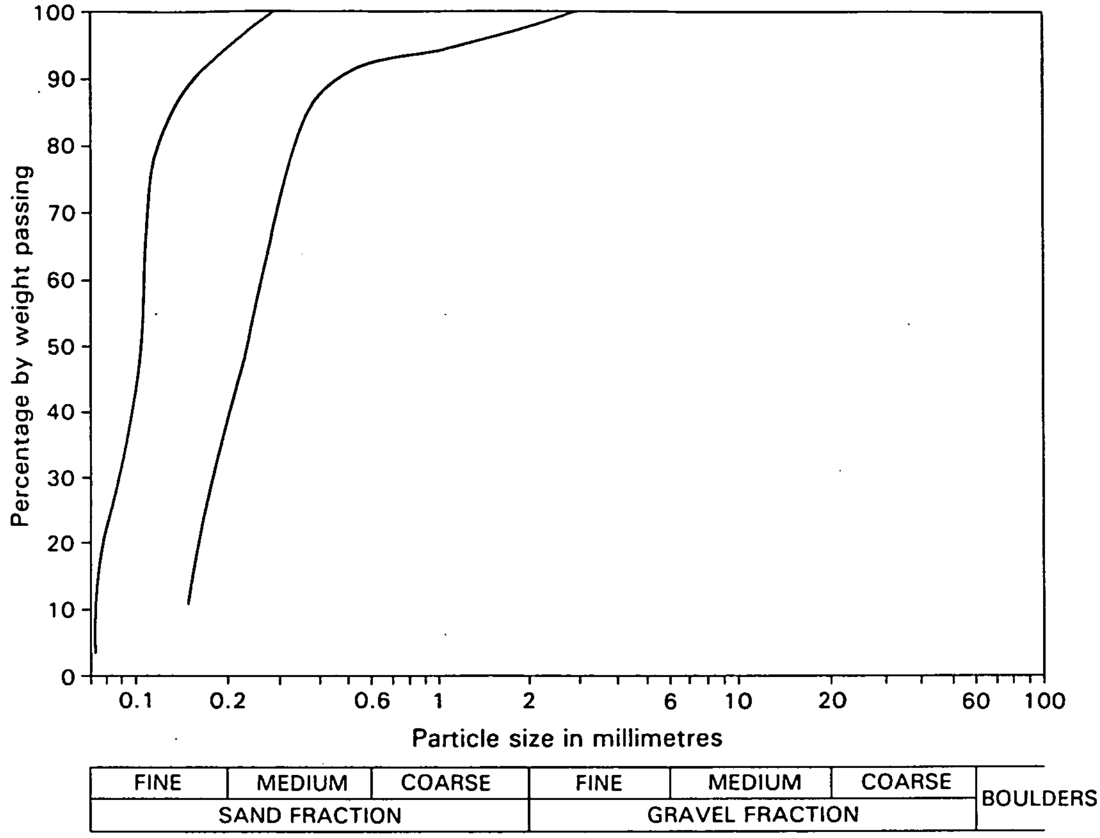

Figure 8. Grading 'envelope' for Whitecliff Sand (20 samples)

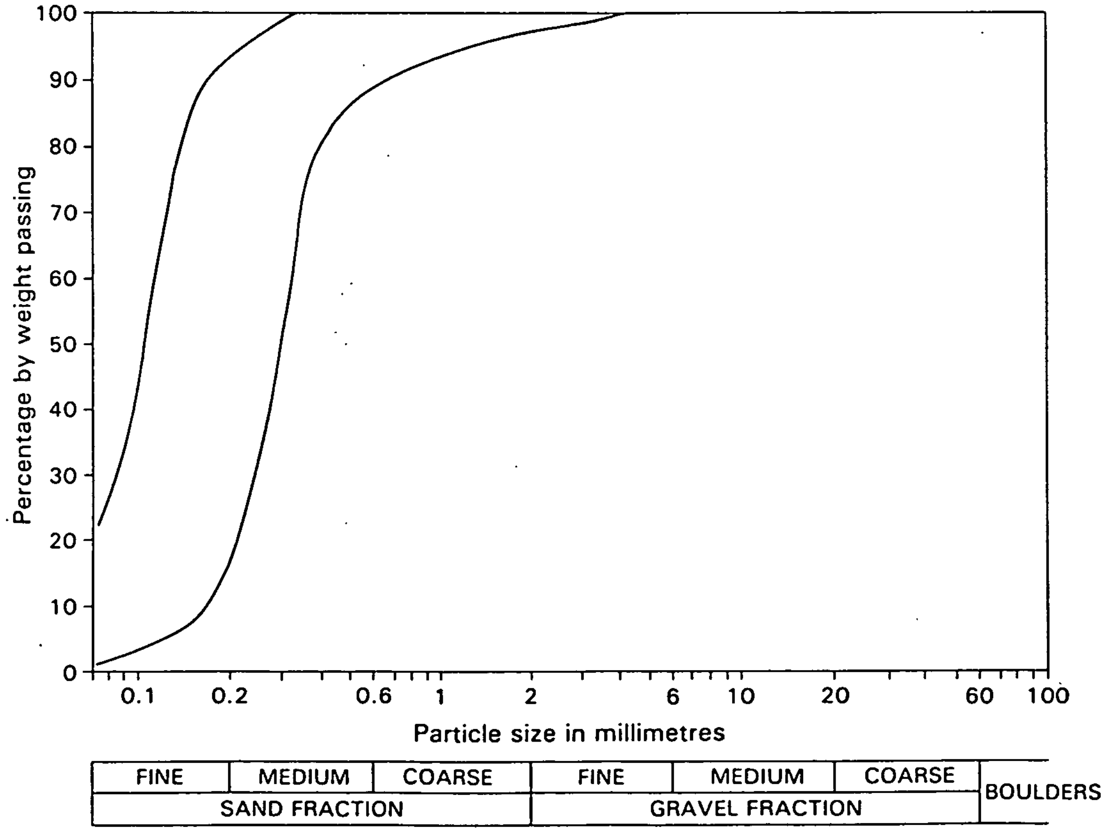

Figure 11. Grading 'envelope' for Marsh Farm Formation (55 samples)

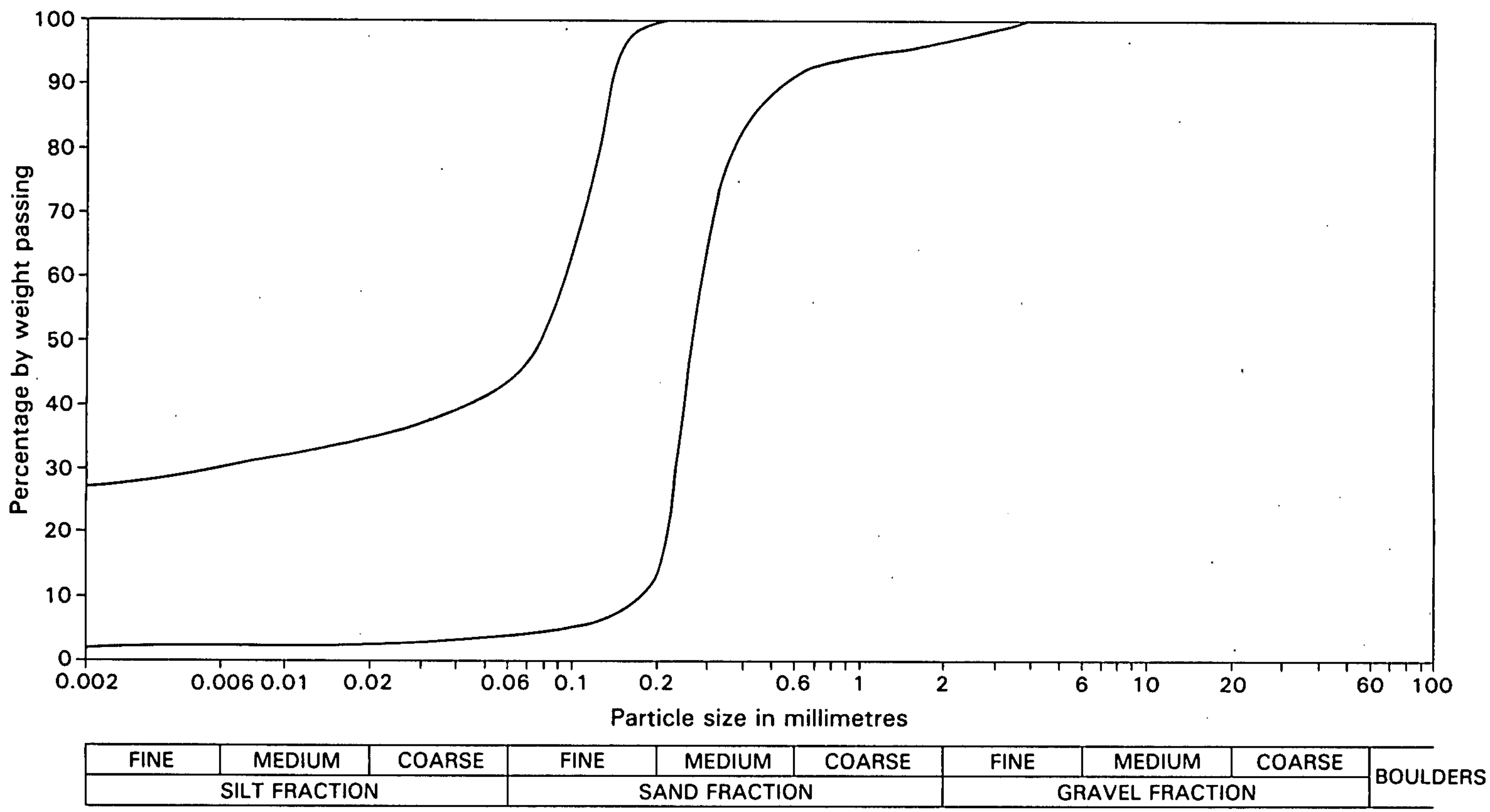

Figure 10. Grading 'envelope' for sand in the Wittering Formation (50 samples)

Clay resources (Map F)

This map is a single sheet at the 1:50 000 scale showing two classes of brick clay resource. In the first class are included formations which may be generally suitable for brick clay. It comprises the Reading Formations, the London Clay Formation and the Barton Clay Formation (excluding sandy horizons mapped in the formations). The second class of resource includes formations which may locally be suitable for brick clay but, because of lithological variation may not everywhere constitute a resource. The second class includes the Wittering Formation and the Marsh Farm Formation (excluding mapped sand units in these formations). A further subdivision of both classes on the map differentiates between areas where the various formations are within about 1.0m of ground surface and areas where more than 1.0m of drift deposits mantle the inferred resource. Areas where possible brick clay resources are buried by other solid formations are not ornamented on the face of the map as the industry usually requires its raw material to be at least partially weathered.

Lithological descriptions of the various clay formations included here as possible brick clay resources, are given in the Appendix, and it is recommended that the reader makes reference to both this and the solid geology maps (A1-6), in addition to Map G.

The stiff red-mottled clays of the Reading Formation have not been much worked for brick making in the project area. Reid (1902) noted that the clays of the Reading Formation were more suitable for tile and pipe manufacture than for bricks. White (1971) states that the Reading Formation clays were formerly used for brick making in the Fareham and Gosport districts. Outcrops of the London Clay Formation were formerly much worked for brick making in the Swanwick [515 097] district within the project area. Reid (1902) stated that the London Clay furnished good brick making material to which little or no sand need be added, provided that it was excavated in a weathered condition. The quality of London Clay worked for brick clay may be adversely affected by the presence of pebble bands or of claystone nodules. The Barton Clay, like the London Clay, is predominantly composed of more-or-less sandy clay, and it has also been worked for brick making in the past. Beds of very glauconitic material may adversely affect the quality to some extent, but a more important consideration is the widespread presence in the formation of calcareous shelly material. Both of the more clay-rich formations of the Bracklesham Group, the Wittering and Marsh Farm formations, are included in the second class of brick clay resource. Both of these formations were formerly worked for brick clay, especially the Wittering Formation. The lack of lateral and vertical consistency in these formations, due to the presence of bodies of sand would render efficient working of these deposits difficult at the present day.