DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

RPT BK. NO. 91/63

CONSTRUCTION SAND DEPOSITS IN THE PORT LINCOLN AREA REPORT NO. 2

GEOLOGICAL SURVEY

BY

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ABSTRACT

About 87 percent of Port Lincoln's construction sand is obtained from pits in the coastal zone between 19 and 22 km by road north of the city. Coarse concrete sand is mined from pits in beach ridge deposits of St Kilda Formation, and finer sand from a pit in aeolian Moornaba Sand. The remaining 13% of the City's sand requirements comes from a deposit of Tertiary age near Strawberry Hill, but this material contains about 10% fines and is blended with clean sand from Louth Bay to meet specifications.

In order to locate alternative sources outside the 800m coastal zone, known deposits in the Central Basin and adjacent western margin of the Lincoln Uplands were examined. As well, logs from the Department's Bore General File were studied. Except for an area between Strawberry Hill and Wanilla, other deposits are either too small or below the water table and do not warrant further investigation.

Several drillholes west and north of Wanilla have intersected significant thicknesses of coarser sand and gravel. Additional drilling would be needed to establish sufficient reserves to maintain long term mining. This sand would require washing to remove fines.

The coastal sand only requires simple screening to remove over-sized material and satisfy specifications. This sand is preferred by local consumers to that from Strawberry Hill, and is also closer to Port Lincoln. Zoning of these coastal deposits for extractive industry is essential to ensure their long term availability.

INTRODUCTION

The bulk of Port Lincoln's construction sand is currently obtained from deposits between North Shields and Louth Bay; these lie within the 800 m Coast Protection Zone. In order to find deposits beyond this zone a survey was undertaken between 12 to 15 February 1990, by the writer and D. Webb (Student).

This investigation follows a previous survey, detailed in Report No. 1, by Nichol (1977) of construction sand resources in the Port Lincoln area which described the coastal deposits and recommended five potential alternate sources. The latter were investigated to determine whether follow-up drilling was warranted to define workable deposits. As well, local sand producers and tenements were visited to ascertain current sand usage and reserves. The Departmental Bore General File was also examined to locate potential deposits in areas north and west of Port Lincoln.

Samples collected during the survey, were sieved at the Department's Glenside Core Library by S.J. Ewen (Technical Assistant). Three samples were submitted to Amdel Ltd for foundry and glass sand testing and results are appended.

GEOLOGICAL SETTING

The accompanying regional geology plan (Fig. 1) is based on LINCOLN (Johns et al., 1958) but uses the stratigraphic nomenclature of Parker (1979) and Thomson (1979). The geology is summarised below and includes data from Nichol (1977).

The oldest rocks within the area investigated comprise Archaean to early Proterozoic metasediments of the Lincoln Uplands and Western Highlands. The former have been partly mantled by Tertiary units including laterite, clay, sand and gravel, which contain zones of coarse sand and are the main potential inland source of construction sand.

Quaternary deposits include Hindmarsh Clay, calcareous aeolianite of Bridgewater Formation, calcrete of Bakara Soil, stranded beach ridges and sediments of St. Kilda Formation, inland siliceous dunes of Moornaba Sand and calcareous and siliceous dunes of Semaphore Sand.

The area investigated comprises four main physiographic units. From east to west these are:

- Eastern Coastal Plain which extends northwards from North Shields.
- Lincoln Uplands, a northeasterly trending uplifted block of basement rocks.
- Central Basin which contains Tertiary sediments overlain by Quaternary alluvium.
- Western Highlands an uplifted basement block adjoining the western coast.

LOCATION AND TENURE

Port Lincoln's construction sand is currently obtained from four deposits listed in Table 1 and shown on Figures 1, 2 and 3. A newly opened deposit south of Tumby Bay is also included. The deposits lie within the District Council of Lower Eyre Peninsula and the Eyre Planning Area. The deposits in the Hd. Louth are within the 800 m Coastal Protection Zone.

TABLE 1

DEPOSIT LOCATION AND TENURE

Deposit	Hundred Section	Distance from Pt. Lincoln (km)	Tenement Holder	*Tenement	Area (ha)	Renewal/ Expiry Date
Louth Bay	Louth 277	22	NT Dickson	EML 3081 EML 3082 EML 5359	16.0 11.0 13.0	31.12.95 31.12.95 25.06.93
Poonindie	Louth 124	19	VH Hage	EML 3203 EML 3245	16.0 16.0	31.12.91 31.12.91
North Shields	Louth 111	19	RD, KE & EM	MC 2588	41.6	15.01.92
Strawberry Hill	Wanilla 138	35	Pioneer Concrete SA Pty Ltd	EML 4966	9.5	30.08.95
Tumby South	Louth 406	41	IK Freeman	EML 5537	1.8	7.11.95

* EML = Extrative Mineral Lease MC = Mineral Claim

PRODUCTION AND USAGE

The average annual recorded production between 1985 and 1989, for the 4 current deposits is presented in Table 2.

TABLE 2

ANNUAL SAND PRODUCTION

Deposit:	Louth Bay	Poonindie	North Shields	Strawberry Hill	Total
Average production (t)	7 800	7 050	1 660	2 400	18 990

Usage from each deposit is discussed below:

- Louth Bay production comprises mainly concrete sand with finer sand used for filling and small amounts as mortar sand and garden loam.

- Poonindie sand is used mainly by Top Australia Pty Ltd in their Port Lincoln plant, where it is blended with superphosphate. Smaller amounts are used for construction and filling sand, and also, when clay is added, as garden loam.

- North Shields currently produces most of the mortar sand used in the area, with some additional construction and filling sand production.

- Strawberry Hill production is used only for concrete sand at the Pioneer batching plant in Port Lincoln, where it comprises about 30% of a blend with Louth Bay sand.

CURRENT SAND SOURCES

Coarser construction sand is obtained mainly from deposits of St. Kilda Formation which are confined to the coastal zone. This sand is pale yellow-brown, medium to coarse grained with alternating fine and coarse layers, some fine gravel and shell rich bands. It also contains minor concentrations of heavy minerals (Morris, 1979) and ranges up to 4 m thick above the water table.

St. Kilda Formation is generally veneered by finer, off-white to pale brown Semaphore Sand up to 3 m thick. This is used for mortar or filling sand. Individual deposits are discussed below:-

Louth Bay - Sand is currently mined from the northern end of EML 5359 and supplies about 70% of Port Lincoln's concrete sand. The pit face exposes up to 2.5 m of finer off-white sand with numerous shell fragments. This overlies 1.2 m of coarser sand which is mined to just above the water table. The sand is screened to remove +6 mm material which comprises mainly shells and shell fragments. Estimated reserves within the three current leases total 450 000 tonnes based on an average thickness of 1.5 m.

Poonindie - Sand from this deposit is similar to the above but reserves are somewhat smaller. Packing sand is obtained from a large pit near the northern end of EML 3203. A nearby pit provides concrete sand which is up to 4 m thick above the water table. Coarse sand which is blended to provide garden loam is obtained from EML 3245 and is screened to remove +6 mm shell fragments.

North Shields - Two types of sand are present on section 111. Coarse concrete sand was formerly won from a pit in the beach ridge deposit in the northern part of the section when it was held under EML 3204.

Finer material for mortar and filling purposes is of aeolian origin and is exposed in pits near the north-eastern corner of MC 2588. Large additional reserves of the pale yellow-brown fine sand

exist to the east in the adjoining section 109.

In addition, fine ferruginised gravel with a thickness of up to 1.5m above water table is exposed in several pits in the western part of section 111.

Tumby South - A recently opened pit on this deposit, up to 2 m deep, exposes 0.8 m of off-white very fine to medium grained sand which overlies 1.2 m of pale yellow-brown slightly clayey sand. Extensive reserves exist within Sec. 406 which are similar to finer sand at North Shields, but no coarser sand was observed in this area. The lease holder reported that several holes drilled near the pit encountered calcrete less than 1 m below the pit floor.

Strawberry Hill - This is the only significant deposit of coarser sand presently mined outside the coastal zone. The pit has exposed:
1-2 m of fine to medium sand with some coarse, pale yellow silty sand.
1.5 m of fine to very coarse, pale yellow brown sand with silty clay bands up to 10 cm thick.
1.0 m of red brown to brown, angular, iron stained gravel with minor fine sand, which was deposited on weathered basement exposed in parts of the pit floor.

Drilling would be required to determine reserves, but areal extent of the deposit is limited. Basement crops out quite close to the pit on western, southern and eastern sides, and reserves are considered unlikely to exceed 40 000 tonnes.

ALTERNATIVE SOURCES

Nichol (1974) in his report on construction sand sources of the Port Lincoln area suggested several potential alternative deposits outside the coastal zone. These were inspected during the compilation of this report and are discussed below. In addition, Departmental Bore Records Files for the area were examined to locate potential deposits. Logs of selected holes are listed in Appendix B and locations shown on Figure 3.

Warunda Creek - Hd Mortlock, Sec 61 and 76. 42 km NW of Port Lincoln. Deposits of coarser, Quaternary sand, associated with old drainage channels, were a source of Port Lincoln's concrete sand prior to development of the coastal deposits in 1956. A pit 250 m long, up to 6 m wide and 2.5 m deep, at sample point 19 (Fig. 3) exposes fine to very coarse, pale yellow-brown sand with minor gravel. However, this and other smaller pits in the area are located in thick scrub, up to 7 m high. Extensive clearing would be required to provide access and further development, and reserves are not sufficient to sustain long term mining. Other creeks to the west in Secs 4, 80 and 81 were investigated but contain no significant accumulations of

coarse sand and do not warrant further investigation.

Wanilla - Hd Wanilla, Sec 120 and 127. 32 km NW of Port Lincoln (Fig. 3). Only a thin veneer of finer sand was observed in Sec 120 and does not warrant further investigation. Deposits of coarser sand occur within the western end of Sec 127 in old creek channels. Barry Hage (Port Lincoln contractor) reported about 3 000 t were obtained by Highways Department in 1985, but as at Warrunda Creek, reserves are limited. The area east and northeast of Wanilla is discussed under Strawberry Hill.

Strawberry Hill - Hd Wanilla, Sec 138. 30-40 km NW of Port Lincoln. As well as the existing pit on Sec 138, described previously, bore records files indicate 9 holes in the area (Fig. 3) have significant coarse sand and fine gravel intersections above the water table. This area on the western slopes of the Lincoln uplands, southwest of Strawberry Hill and southeast of Wanilla, has good potential. Six of the holes record sand intersections up to 10 m thick, but as with sand from other Tertiary deposits in the State, it would require washing to remove excess fines.

Lake Wangary - Hd Lake Wangary, Sec 127. 46 km WNW of Port Lincoln. A large deposit of suitably sized sand occurs at the mouth of the a creek at the northeastern side of the lake.

However, the area is environmentally sensitive, being within sight of Flinders Highway. Also, the longer distance and very difficult winter access makes this deposit unattractive to Port Lincoln sand producers with whom it was discussed.

Edillilie - Hd Mortlock, Sec 14. 48 km NNW of Port Lincoln. This deposit comprises dunes of aeolian Moornaba Sand which is too fine for concrete and suitable only for mortar or filling sand. As similar material can be obtained closer to Port Lincoln, this deposit is considered to have no potential.

The logs of numerous holes in the Central Basin (Fig. 3) were examined. Significant thicknesses of Tertiary sand are indicated beneath 2.5 to 10 m of soil and Quaternary clay. However, in most holes water is encountered at the base of the clay or beneath an upper, fine Tertiary sand unit. Coarse sand or gravel generally occurs below the water table. Only four holes west of Wanilla encountered mineable thicknesses of coarse sand above the watertable. As significant quantities of overburden would have to be removed, the potential of this area is considered to be much lower than the area near Strawberry Hill.

Logs of holes in the Eastern Coastal Plain were also examined for potential deposits outside the coastal zone. Sediments comprise a veneer of red-brown, slightly sandy Hindmarsh Clay with minor, basal gravel overlying basement. This area is considered to have no potential for sizeable sand deposits.

RESULTS OF TESTING

Samples were sieved according to specification AS 1141-1974 and results are presented graphically in Appendix A. Specification AS 2758.1-1985 which defines grading limits for natural fine aggregates, is shown as a broad envelope on these graphs. More rigid specifications for individual products fall within the envelope.

Size grading can also be conveniently represented by two simple parameters:

- Fineness Modulus (FM) on a 'fines-free' basis (Appendix A)

- Fines content or percentage of minus 0.075 mm material (ie. silt and clay).

The finest sand which meets AS 2758.1-1985 specification has a FM of 1.35, and the coarsest has a FM of 4.00. Numerous specifications exist for concrete sand, but generally a FM between 2.0 and 2.5 is preferred. Maximum permissible fines content is 5 per cent. Sand with a higher fines content requires washing to conform to this specification. Results are summarised in Table 3 from data in Appendix A. Sample locations are shown on Figures 2-4.

TABLE 3

SUMMARY OF SIZE ANALYSES

Sample No.	Location	Tenement (E.M.L)	F.M.	Fines%	Description
1	Louth Bay	3081	1.43	0.7	Fine Sand up to 2.5m thick
2		3081	2.76	0.6	Underlying sand with shell fragments
3		5359	1.32	0.4	Fine and coarse sand from
4		5359	3.91	0.3	currently worked pit
5	Poondindie	3203	1.31	0.9	Packing sand used by Top Australia
6		3203	2.39	0.6	Mined as concrete sand
7		3245	3.26	1.7	Coarse sand which is blended with clay for garden loam
8	North Shields	-	1.42	4.5	Fine sand samples also
9		*3205	1.79	3.0	tested for foundry and glass
10		*3205	1.57	2.1	sand potential
11		*3204	3.53	0.8	Sand used for concrete
12		-	3.67	0.3	Fine gravel deposit
13		*3205	1.77	2.4	Used for mortar sand
14	Tumby South	5537	1.17	3.0	From top 0.8m in pit
15		5537	1.23	4.4	Lower part from 0.8-2.0m
16	Strawberry Hill	4966	2.30	9.8	Top 1.2m in pit
17		4966	2.59	10.9	Lower portion about 1.5m thick
18		4966	5.11	22.8	Gravel at base, up to 1.0 thick
19	Sec. 61 Hd Mortlock	-	3.08	3.3	Sand from Warunda creek

Note: * indicates lease now cancelled.

Concrete sand from the Louth Bay deposit (Sample 4) is screened to remove + 6 mm material, mainly shell fragments. Pioneer blend this with Strawberry Hill sand (Samples 16 & 17) which has an excessive clay/silt content, all other samples are within the 5% maximum fines limit. The near coastal sand generally has a fines content less than 1.0%, however, most brick layers like the finer sand with a higher clay content and prefer sand from the North Shields area with fines content ranging up to 4.5%. Sand from the Tumby South deposit has a satisfactory fines content, but is marginally below the FM specification.

According to the leaseholder, bricklayers in the Tumby Bay area are quite satisfied with his product.

Results of foundry and glass sand analyses on Samples 8 to 10 are listed in Appendix B. The deposits appeared to have potential due to sizing and minor clay discoloration. However, detailed examination indicates that the discoloration is caused mainly by iron staining, particularly of the numerous fractured feldspar grains. This renders the sand unsuitable for glass manufacture. Size gradings are unacceptable for foundry use due to the wide range of grain sizes present.

CONCLUSIONS AND RECOMMENDATIONS

The bulk of Port Lincoln's construction sand is obtained from three deposits north of the city, within the Coastal Protection Zone. Coarse sand is mined from Quaternary deposits of Saint Kilda Formation, and finer sand from aeolian Moornaba Sand formation. Locations and main products from these are as follows:

- Louth Bay - concrete sand (St Kilda Formation)
- Poonindie - packing sand (St Kilda Formation)
- North Shields - mortar sand (Moornaba Sand).

Concrete sand is also mined from a Tertiary deposit near Strawberry Hill, on the western margin of the Lincoln Uplands. However, this material contains excessive fines and is blended with sand from Louth Bay to meet specifications.

An investigation of alternative sources outside the coastal zone was undertaken. Only the Strawberry Hill - Wanilla area has any potential, although drilling would be required to establish reserves to sustain long term mining, and sand from this area would require washing to remove silt and clay.

Only the three coastal deposits contain sufficient reserves to meet Port Lincoln's long term requirements. This sand meets specificiations simply by screening to remove oversized material and is located within 22 km of the city. To ensure continuity of supply it is strongly recommended that these deposits be zoned for Extractive Industry.

for D C SCOTT
SENIOR GEOLOGIST

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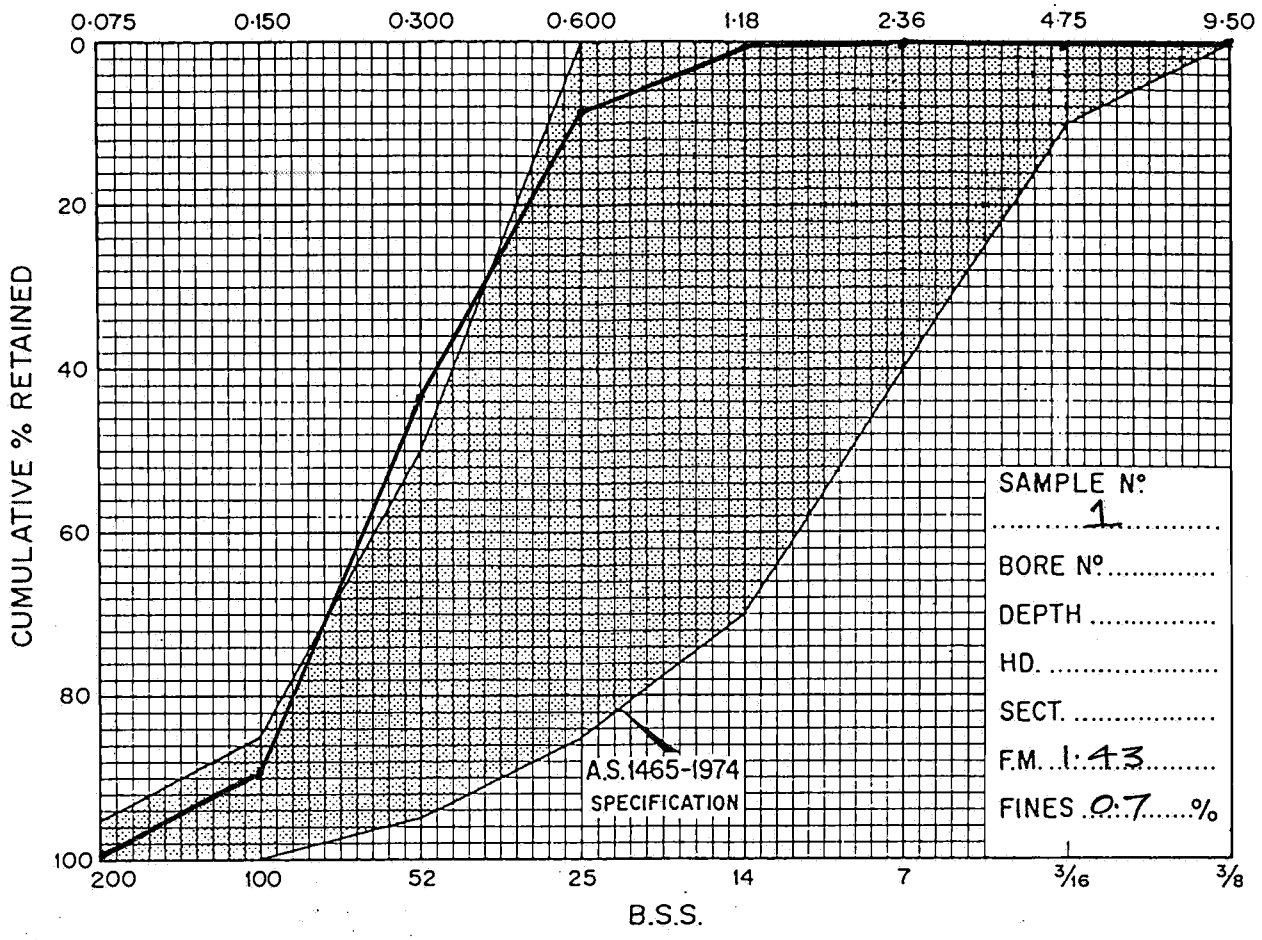
APPENDIX A

SIEVE SIZING ANALYSES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CUMULATIVE % RETAINED
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B.S.S.
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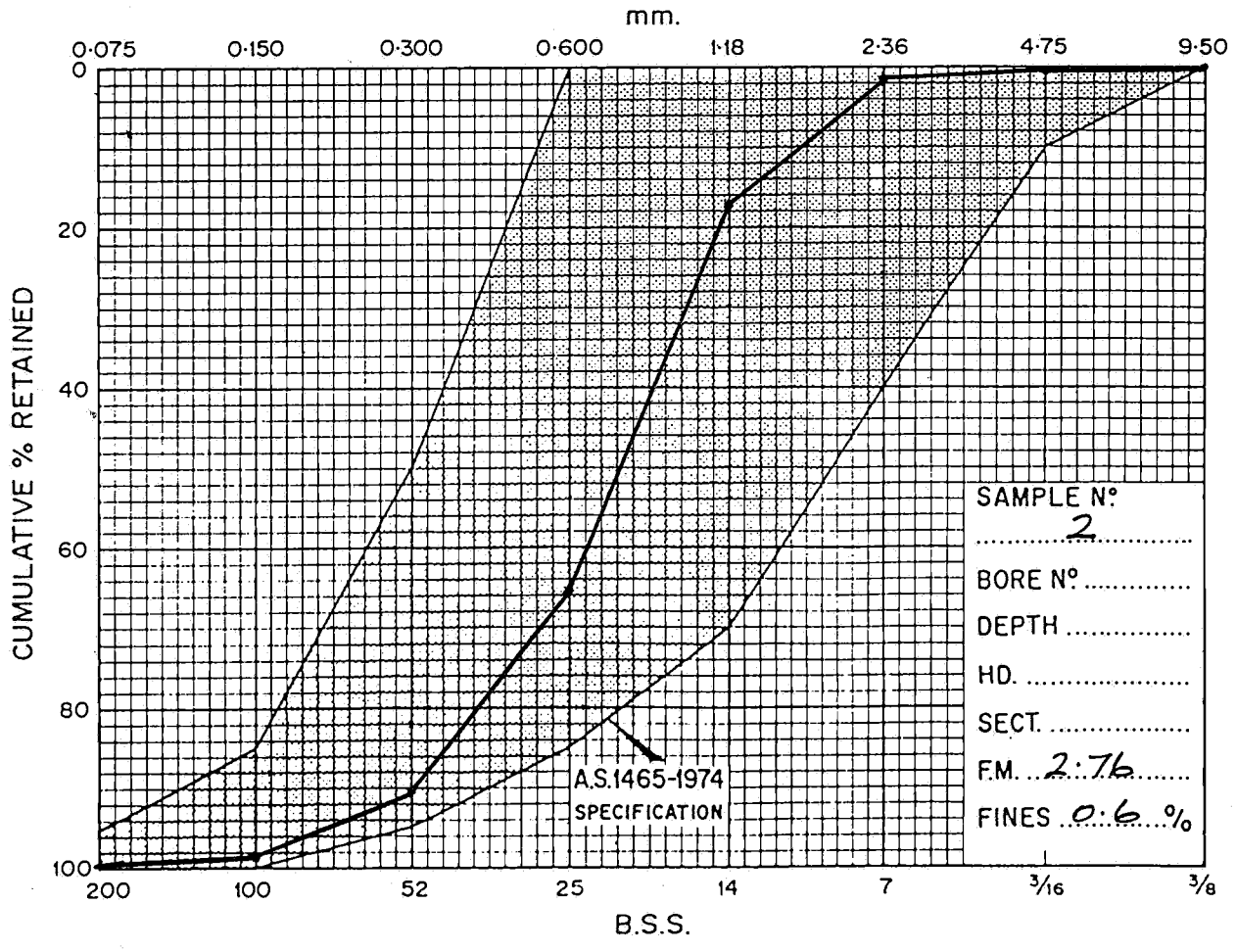
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CUMULATIVE % RETAINED
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B.S.S.
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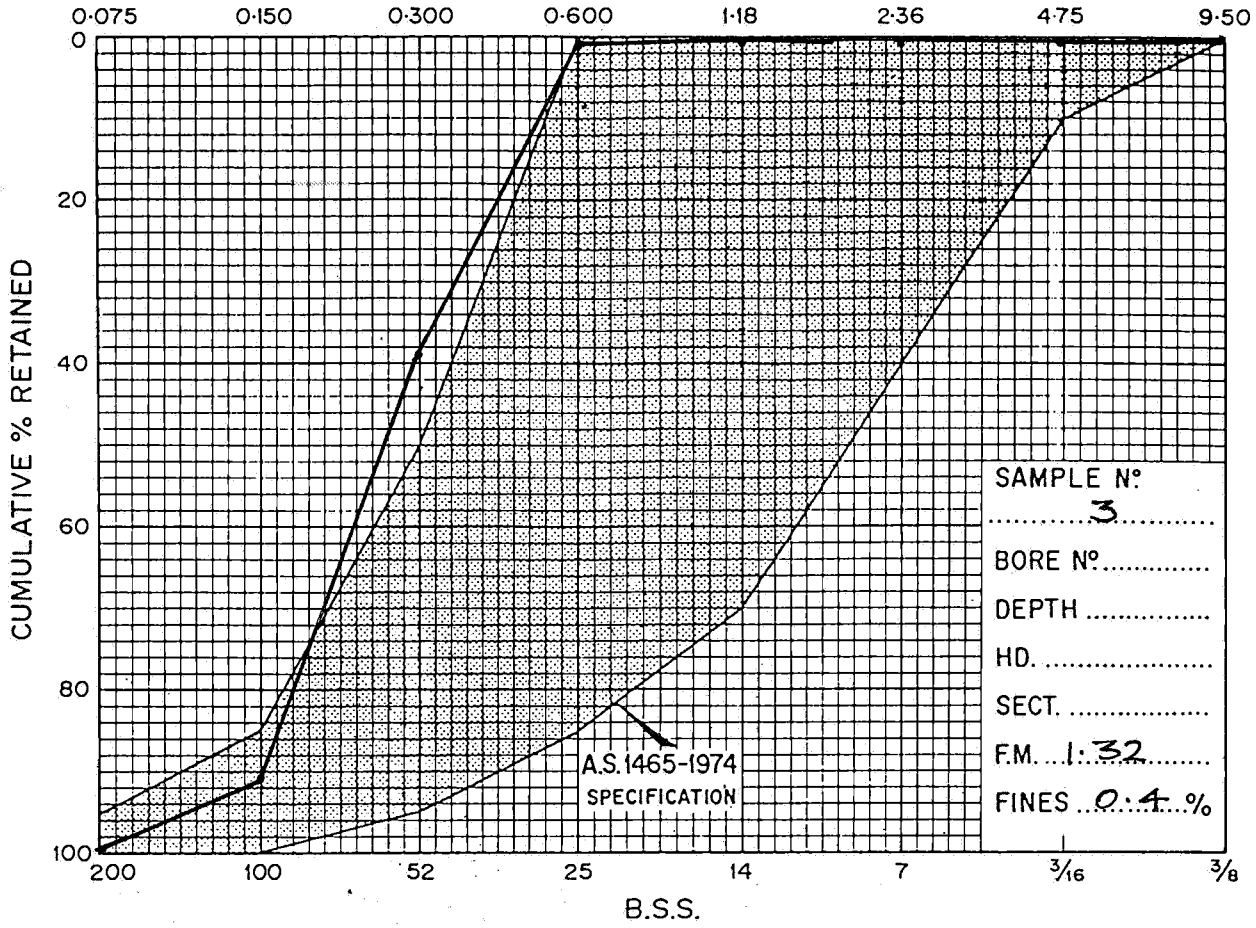
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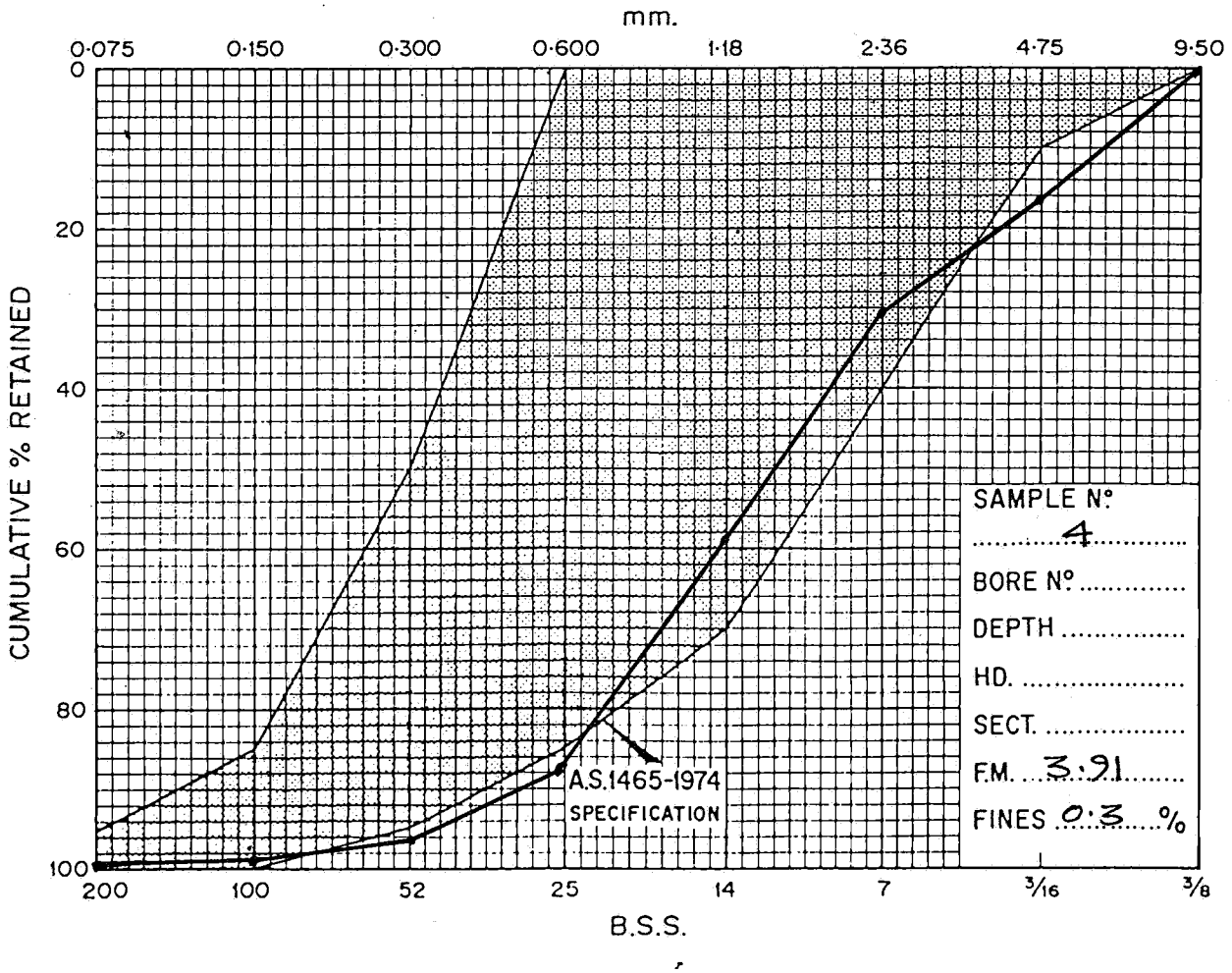
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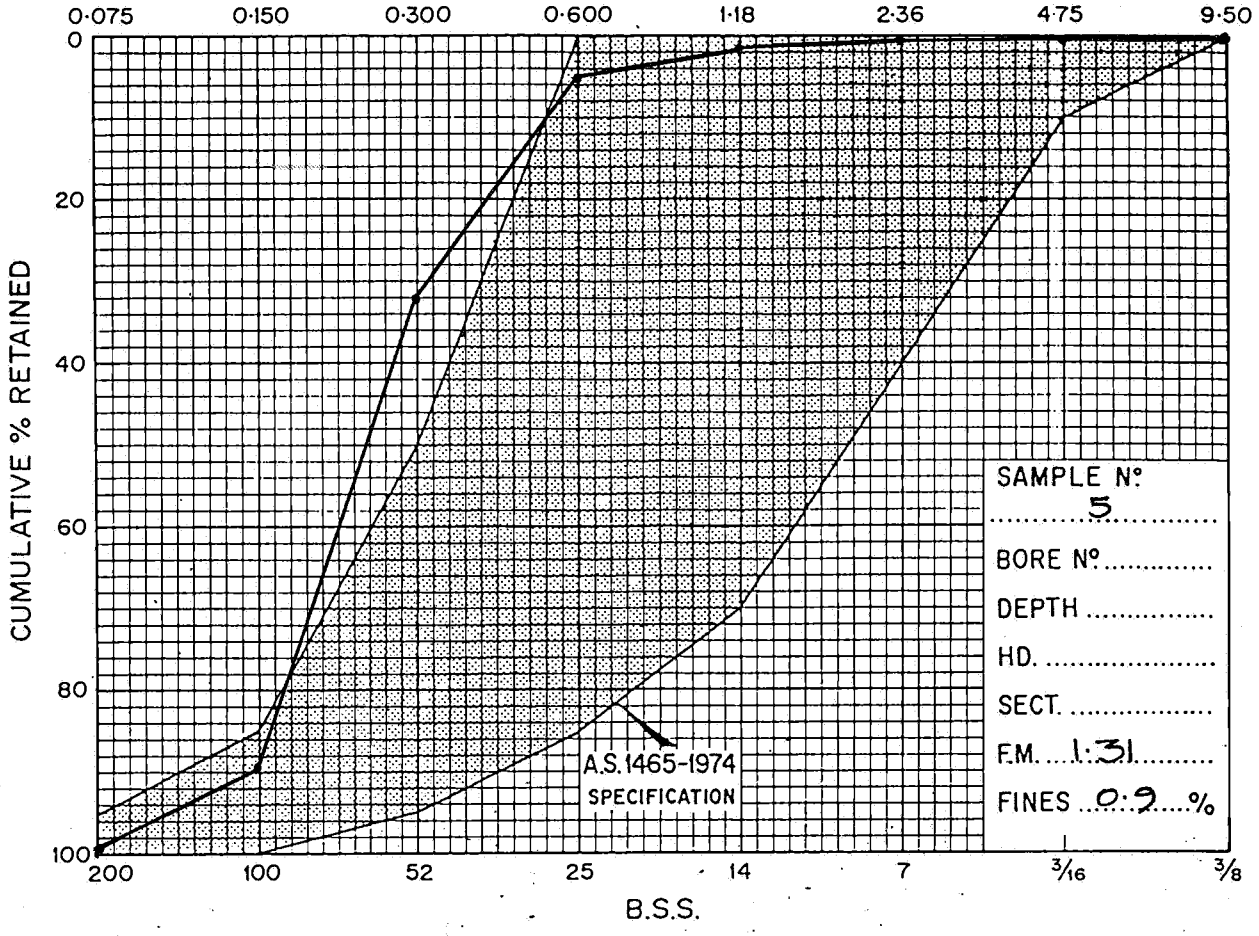
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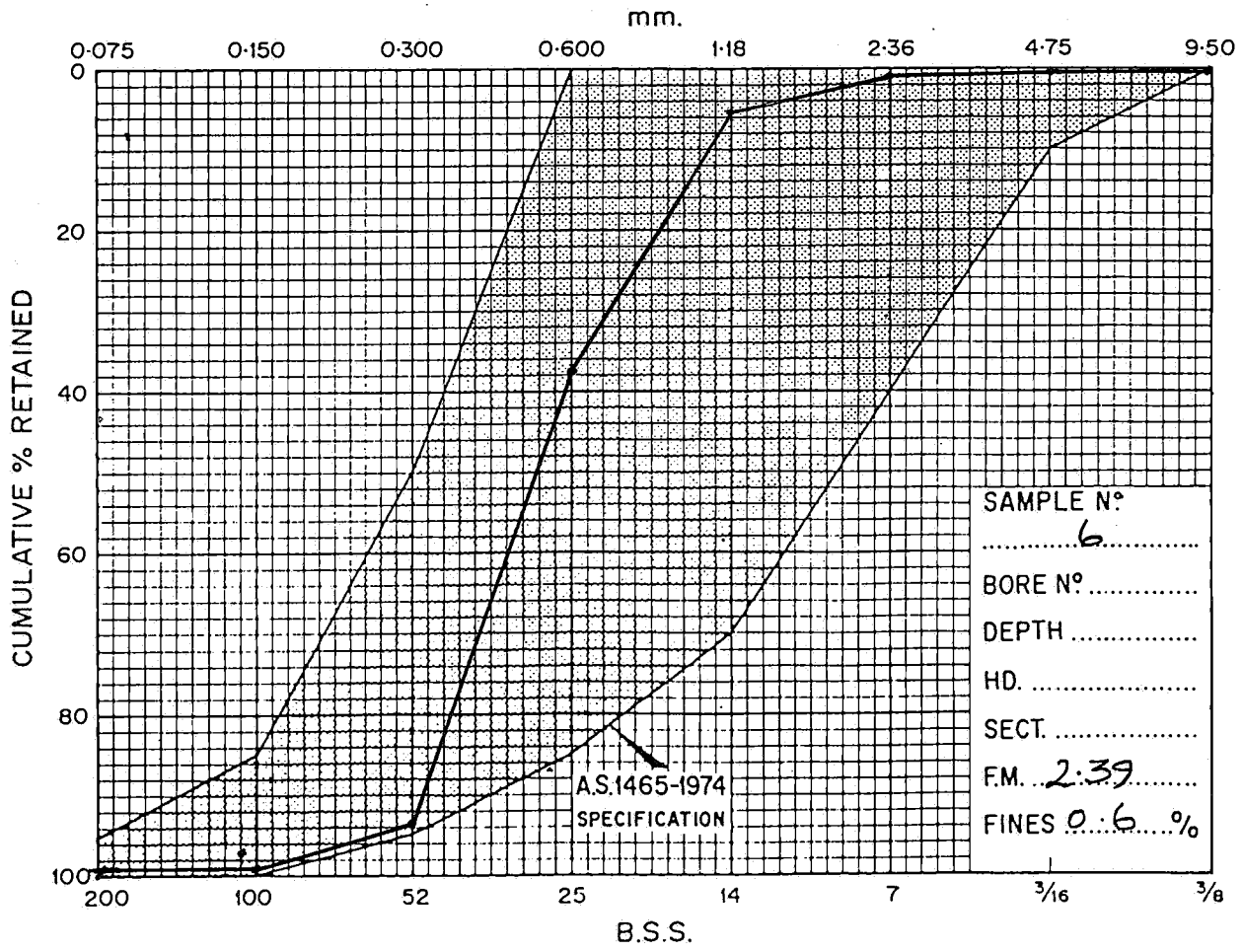
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B.S.S.
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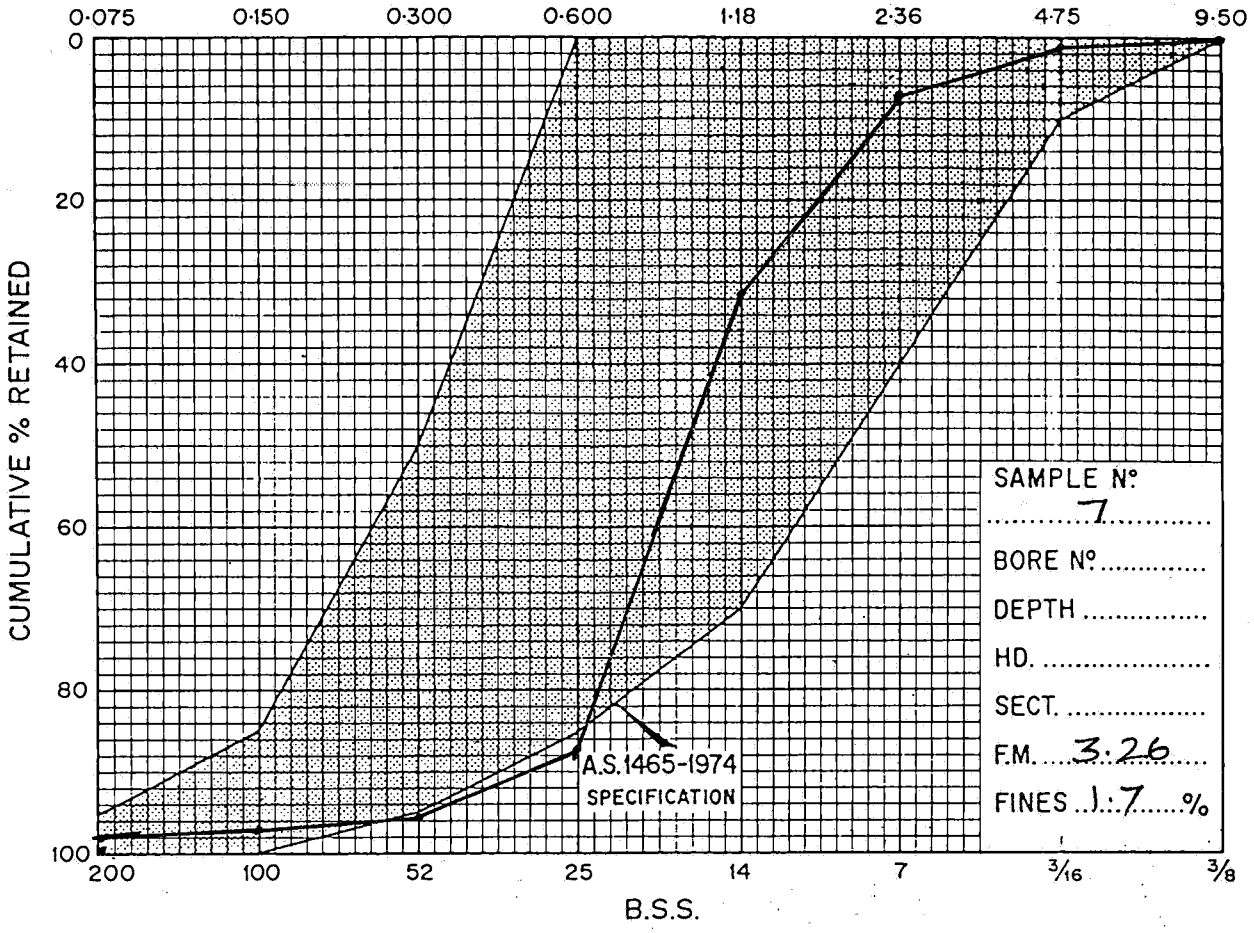
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BORE N°
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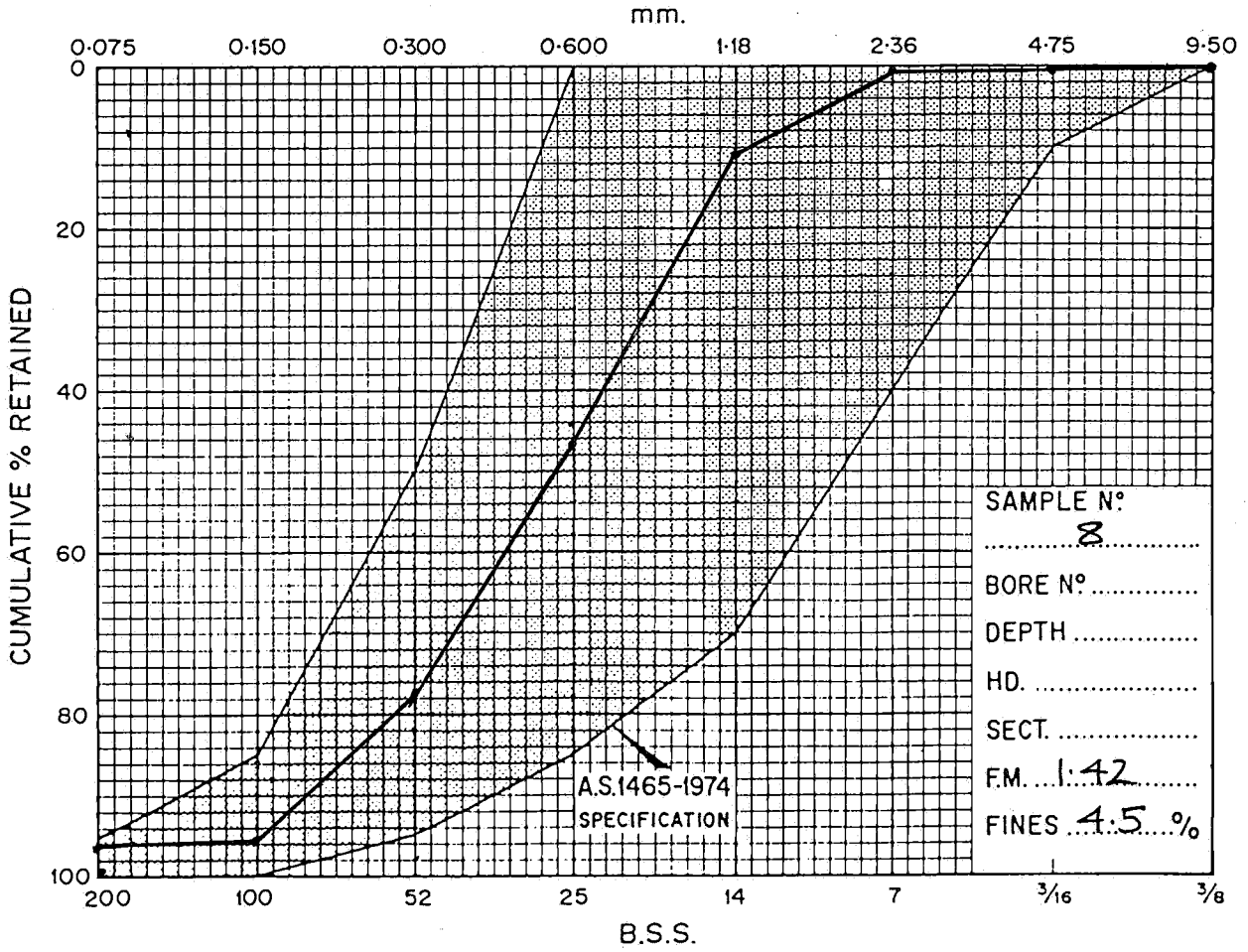
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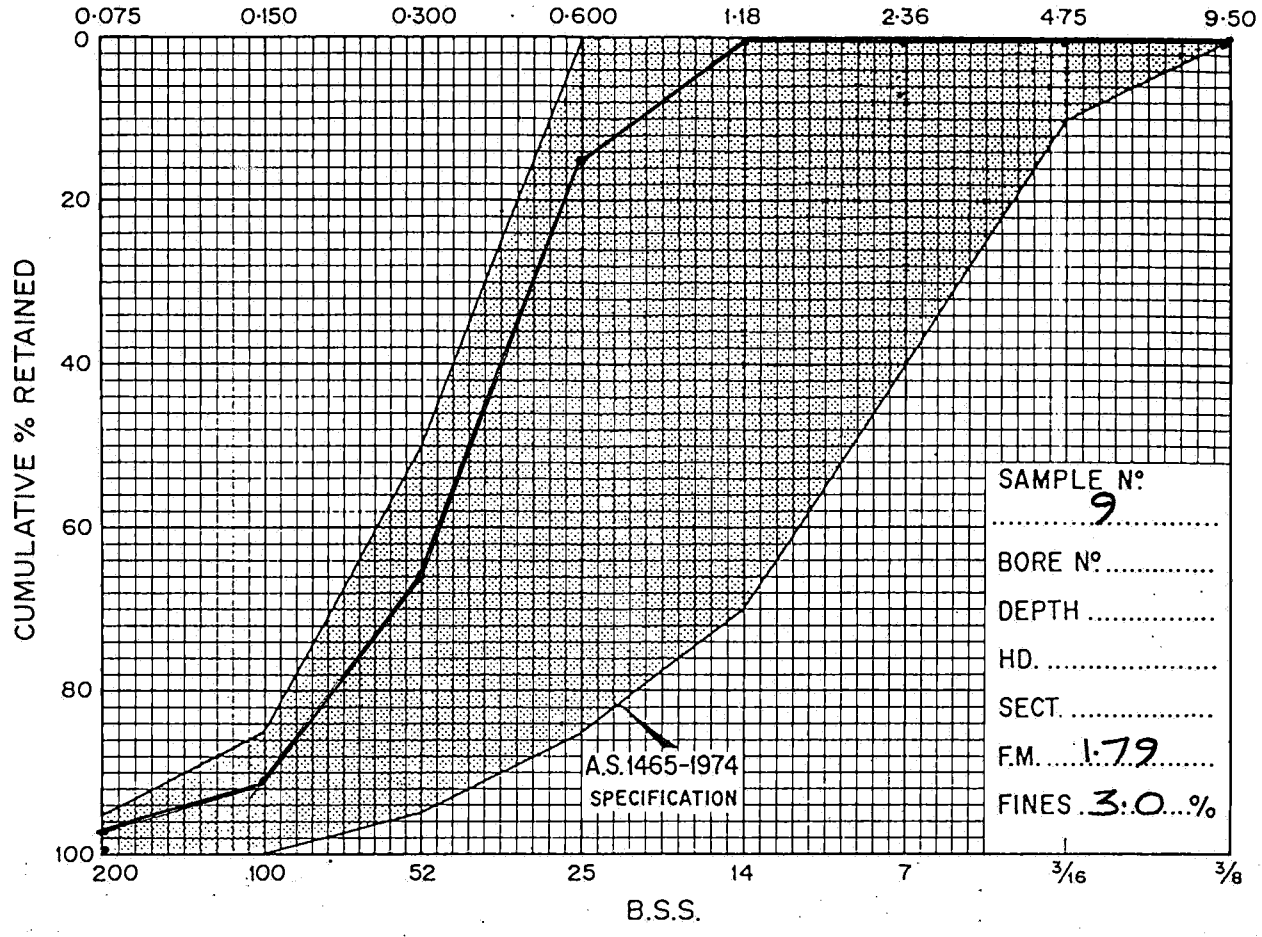
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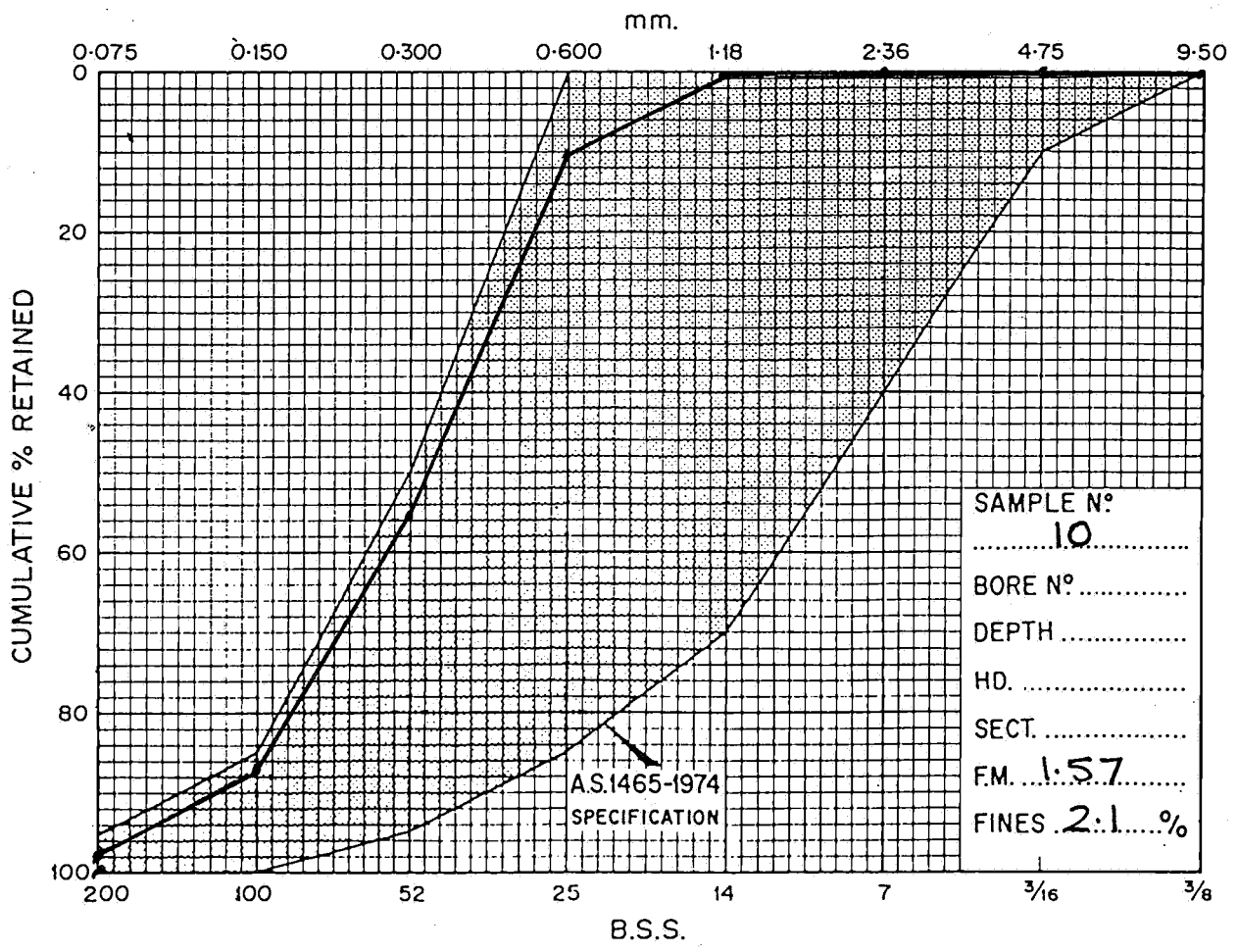
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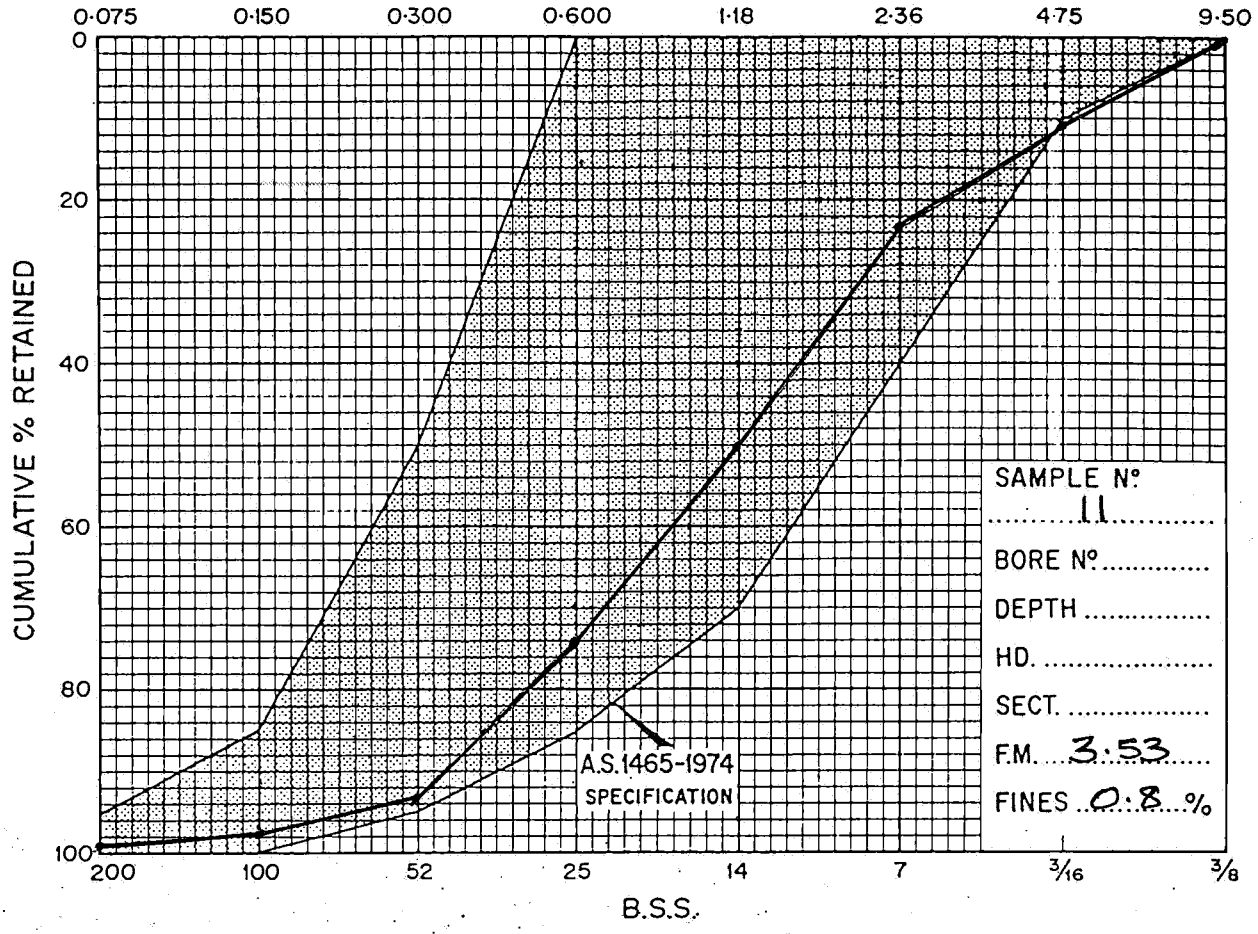
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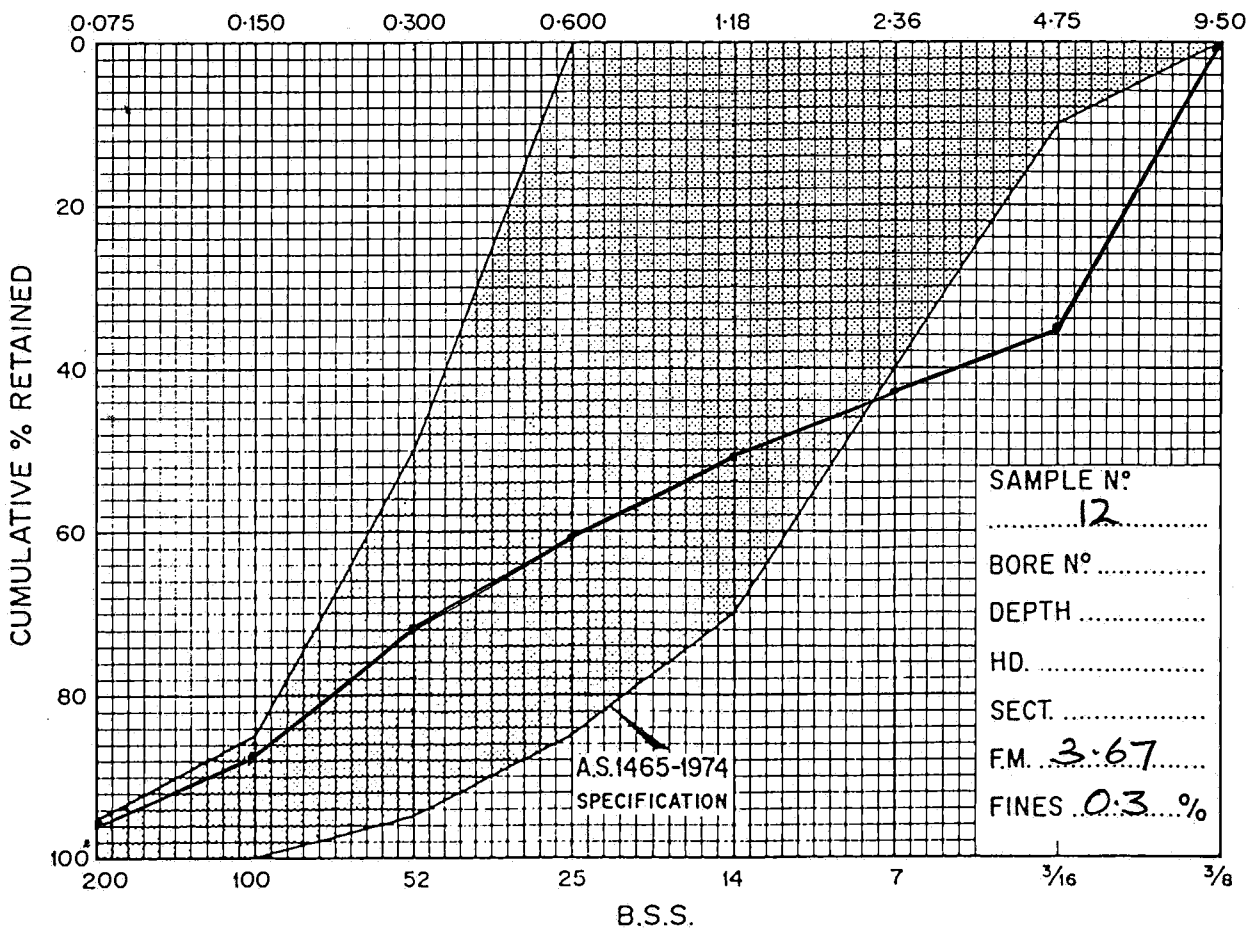
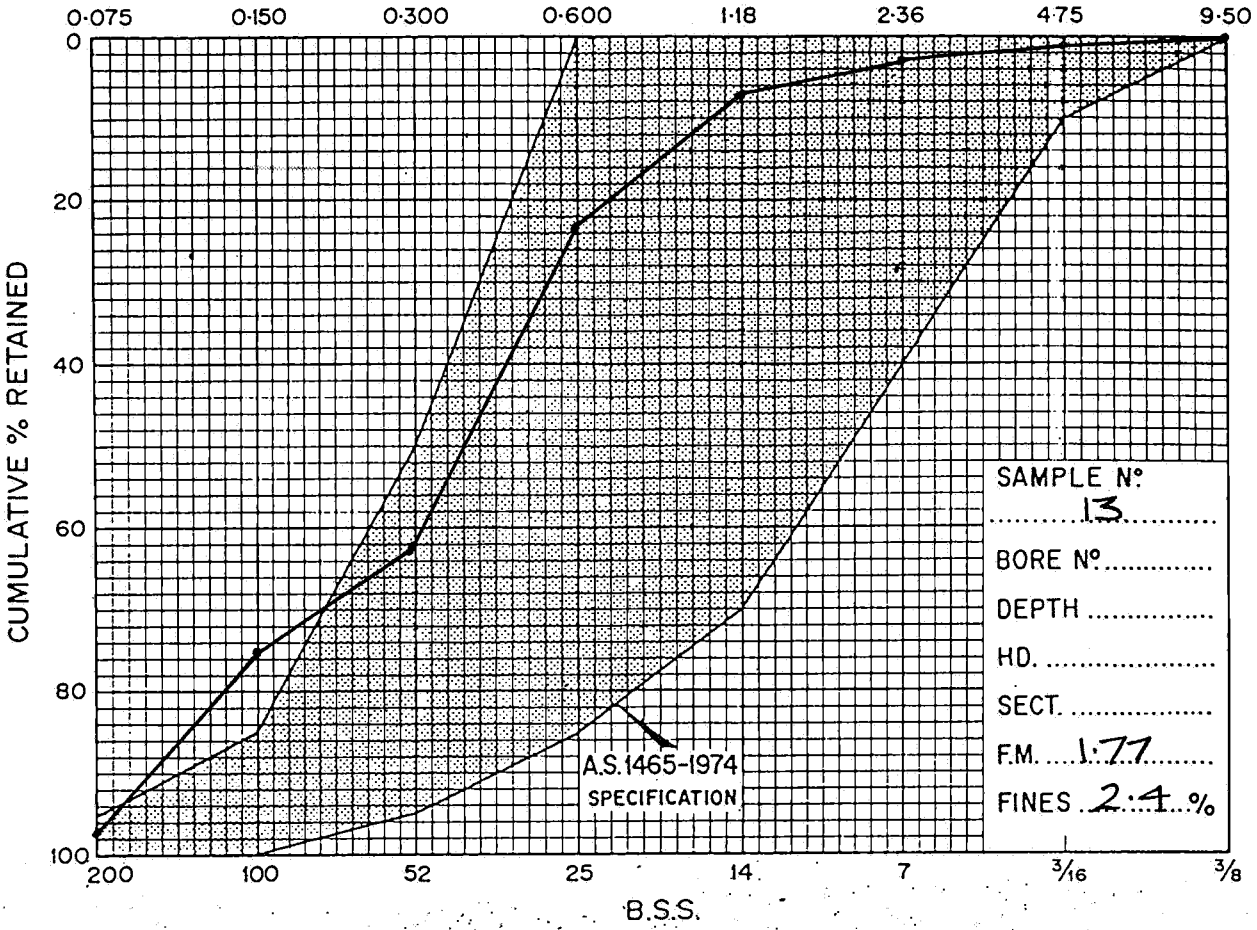
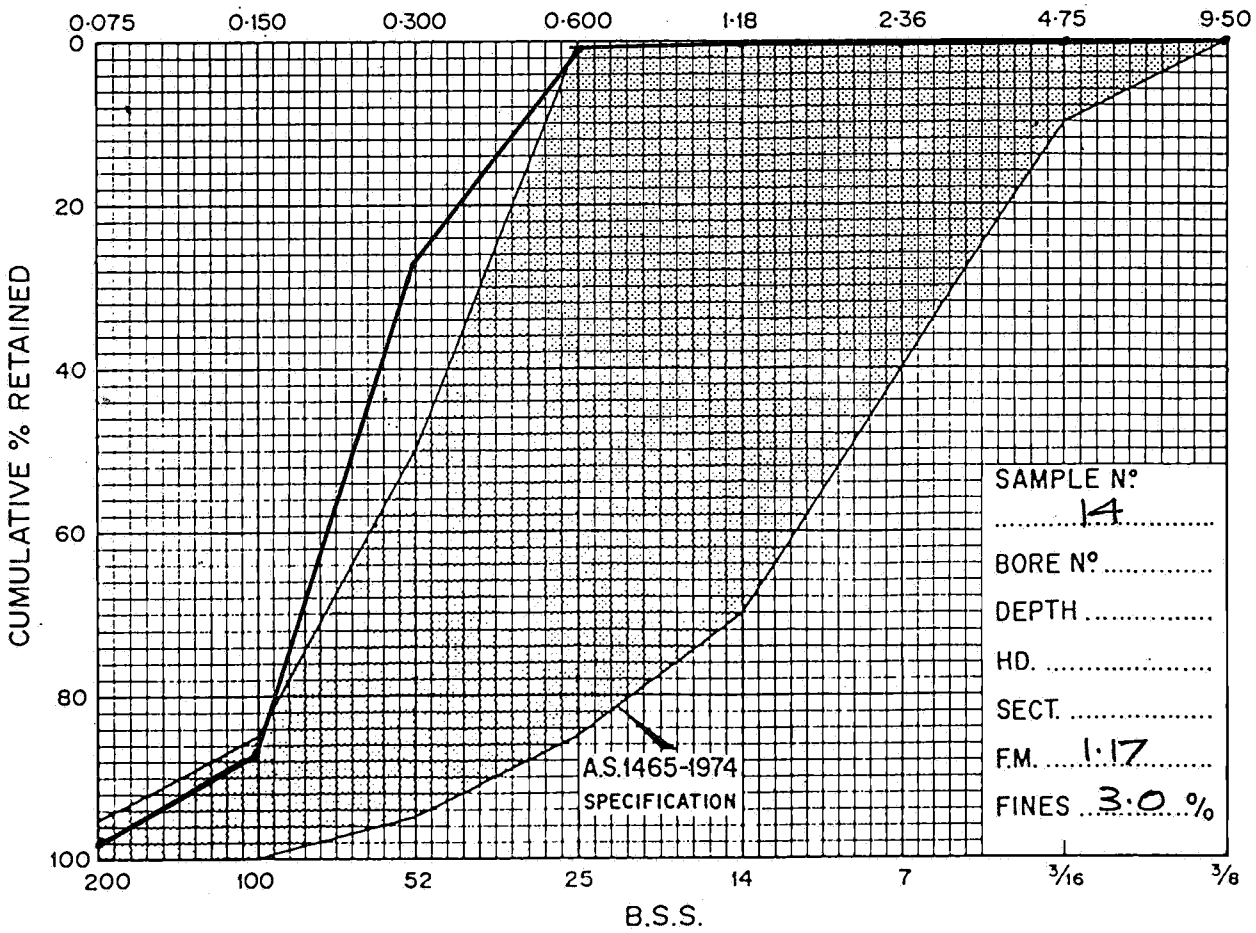
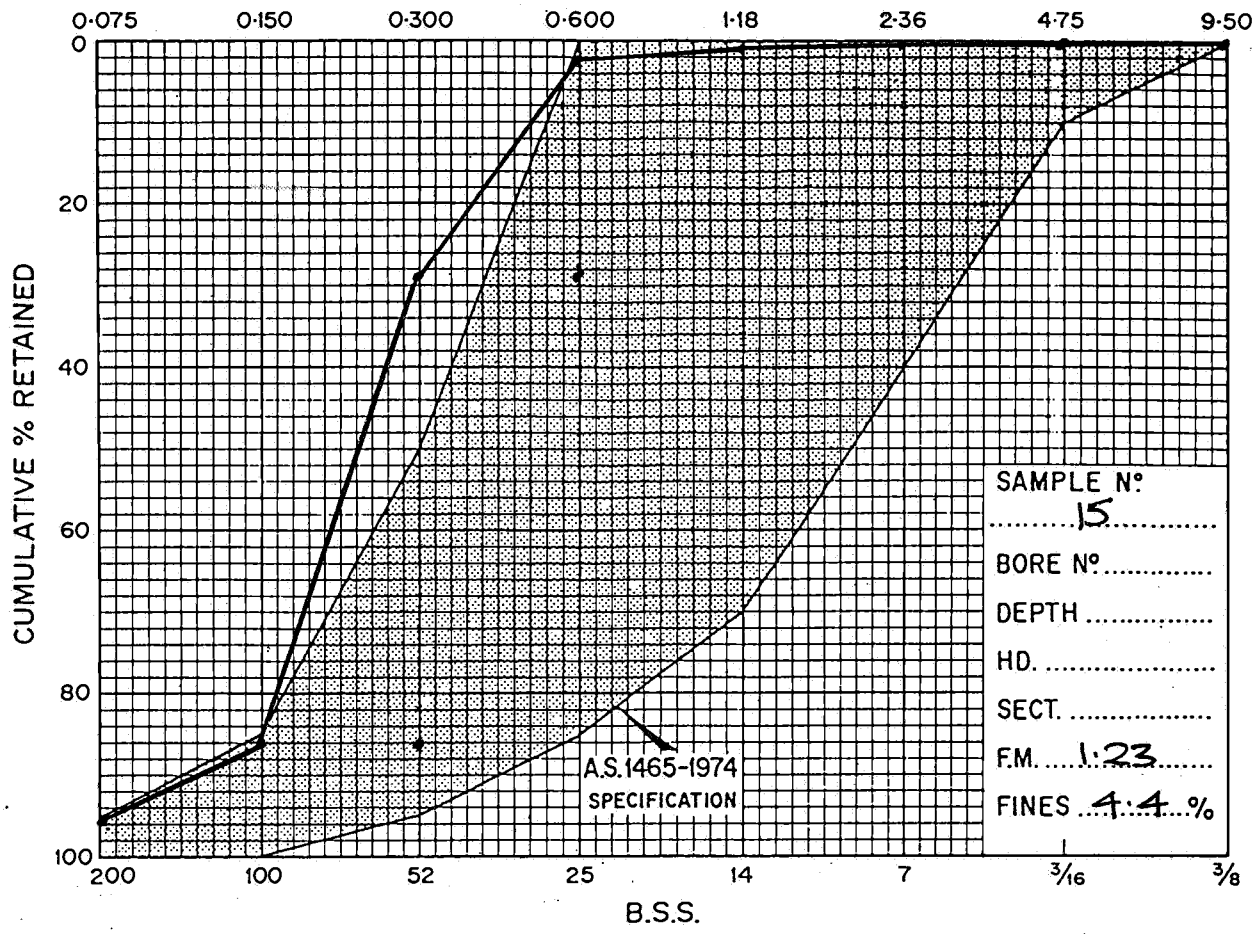
3/8
B.S.S.
mm.
A.S.1465-1974
SPECIFICATION
SAMPLE Nº
11
BORE Nº
DEPTH
HD.
SECT.
F.M. 3·53
FINES 0·8 %


0·075
0·150
0·300
0·600
1·18
2·36
4·75
9·50
0
20
40
60
80
100
CUMULATIVE % RETAINED
200
100
52
25
14
7
3/16
3/8
B.S.S.
mm.
A.S.1465-1974
SPECIFICATION
SAMPLE Nº
12
BORE Nº
DEPTH
HD.
SECT.
F.M. 3·67
FINES 0·3 %


0·075
0·150
0·300
0·600
1·18
2·36
4·75
9·50
0
20
40
60
80
100
CUMULATIVE % RETAINED
200
100
52
25
14
7
3/16
3/8
B.S.S.
mm.
A.S.1465-1974
SPECIFICATION
SAMPLE N°
13
BORE N°
DEPTH
HD.
SECT.
F.M. 1·77
FINES 2·4 %


0·075
0·150
0·300
0·600
1·18
2·36
4·75
9·50
0
20
40
60
80
100
CUMULATIVE % RETAINED
200
100
52
25
14
7
3/16
3/8
B.S.S.
A.S.1465-1974
SPECIFICATION
SAMPLE N°
14
BORE N°
DEPTH
HD.
SECT.
F.M. 1·17
FINES 3·0 %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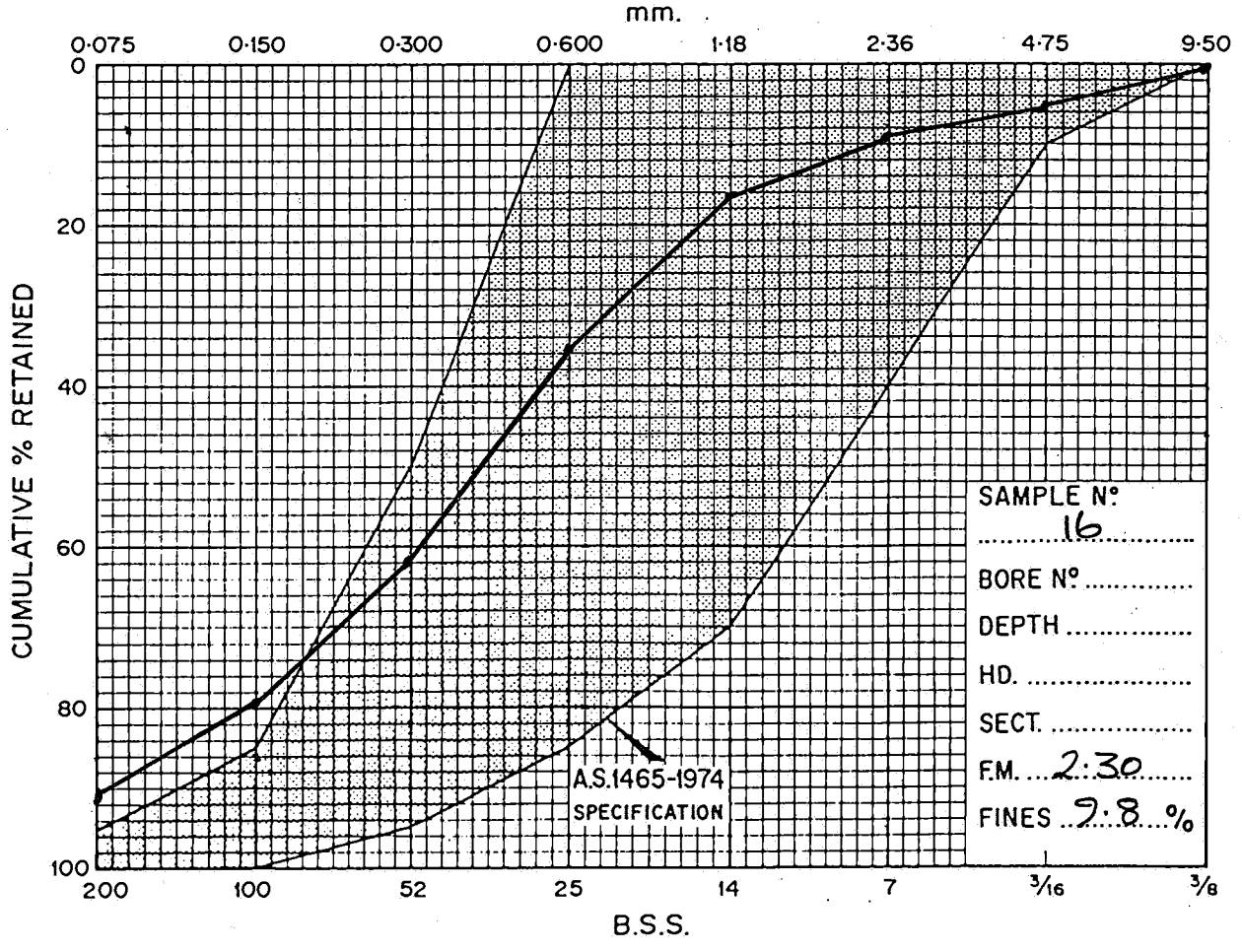
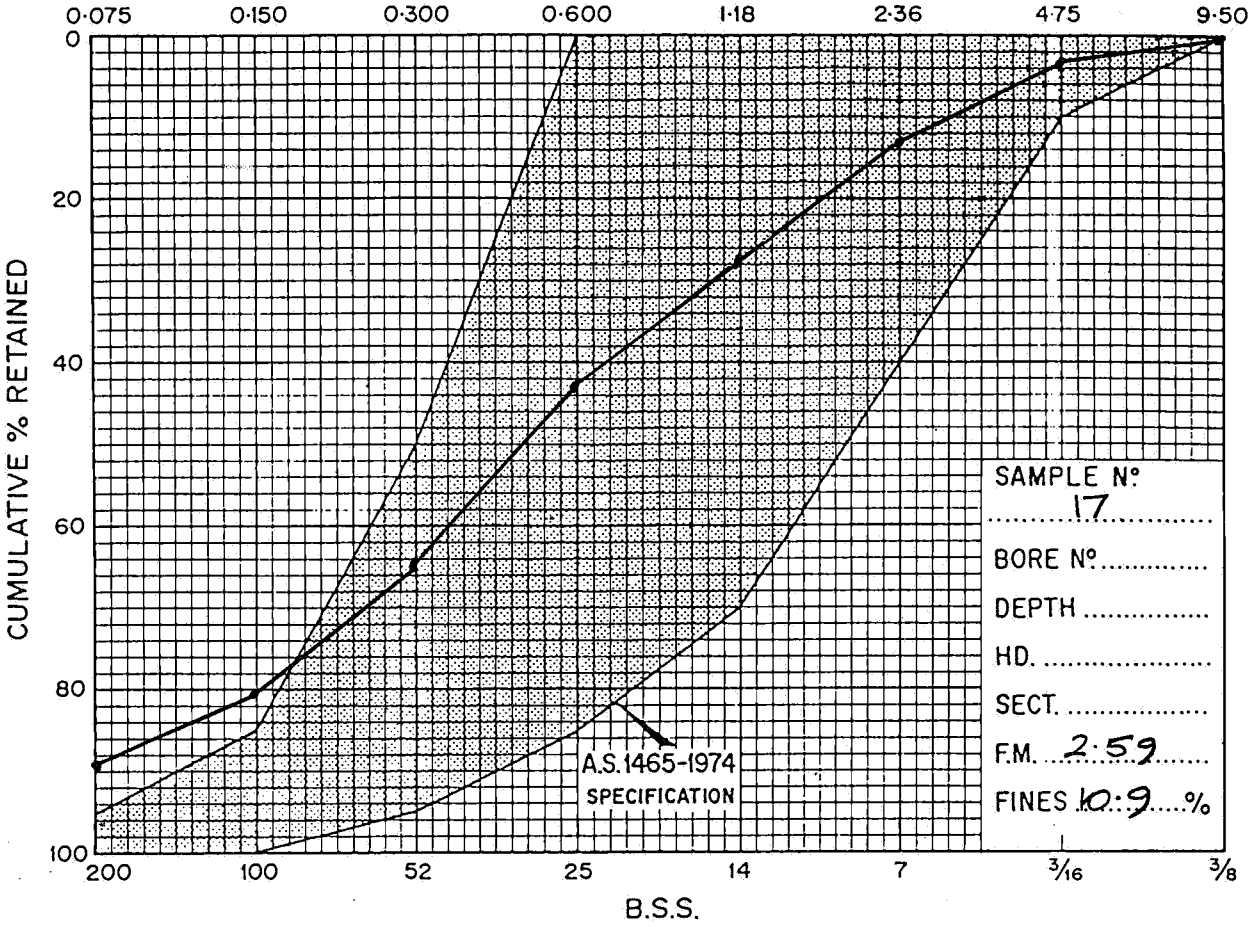
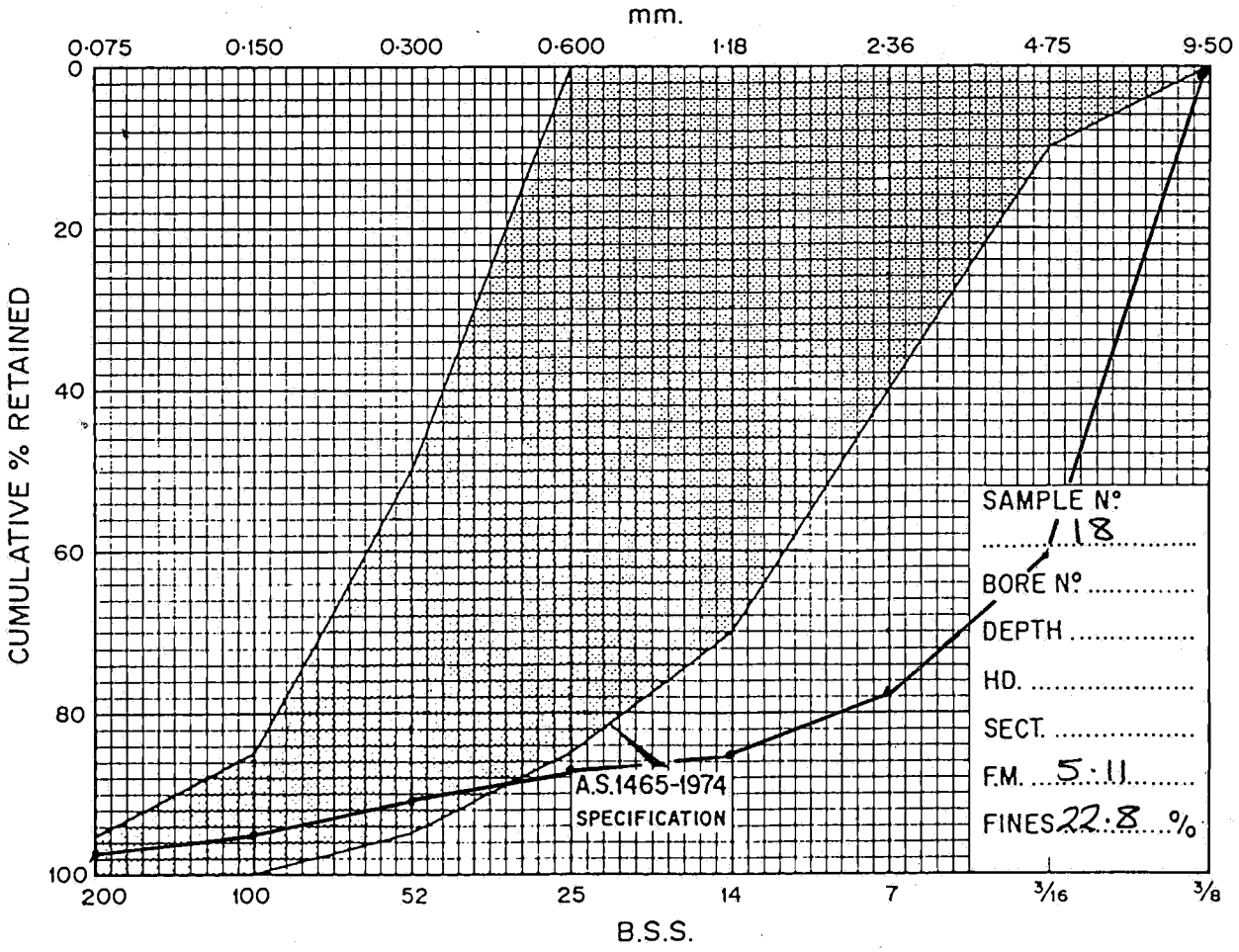
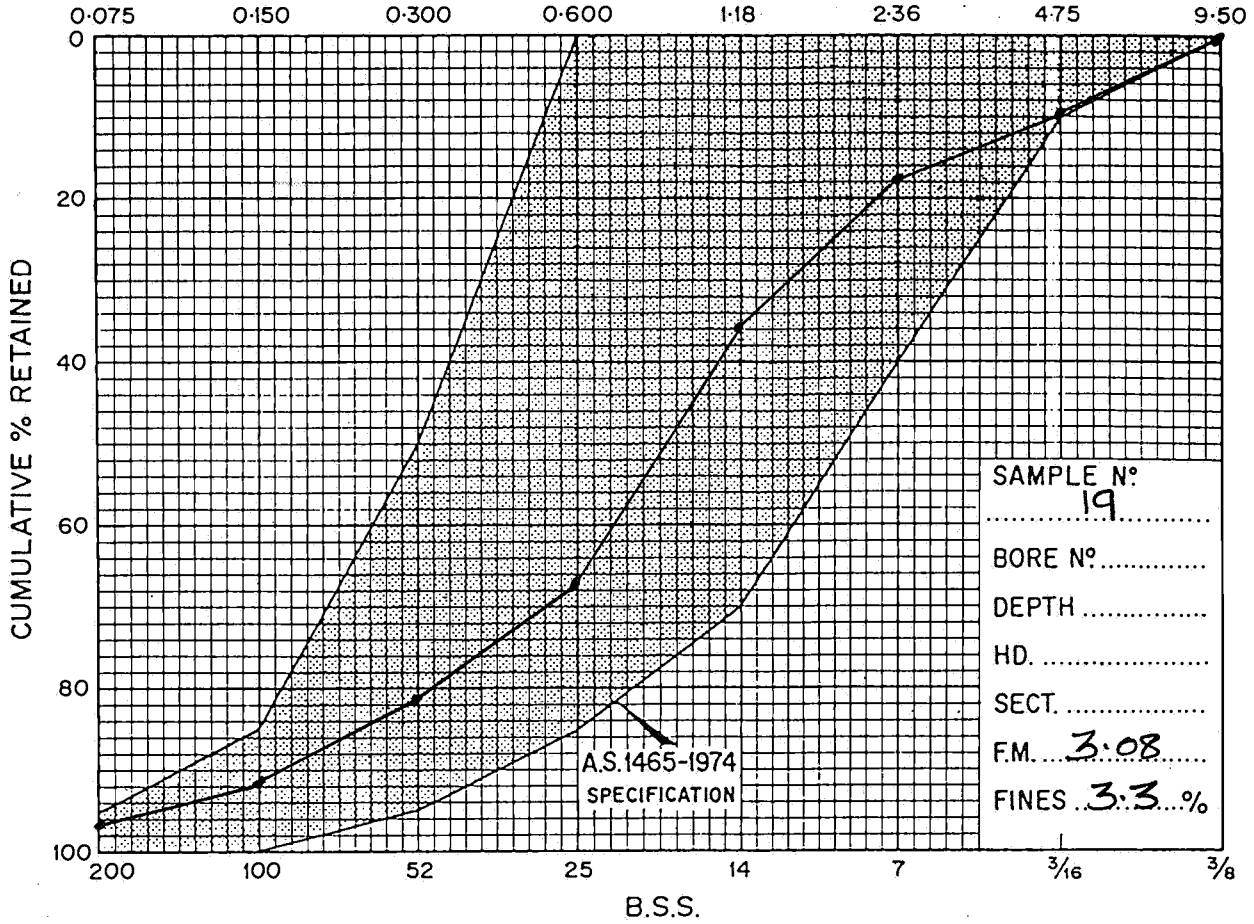
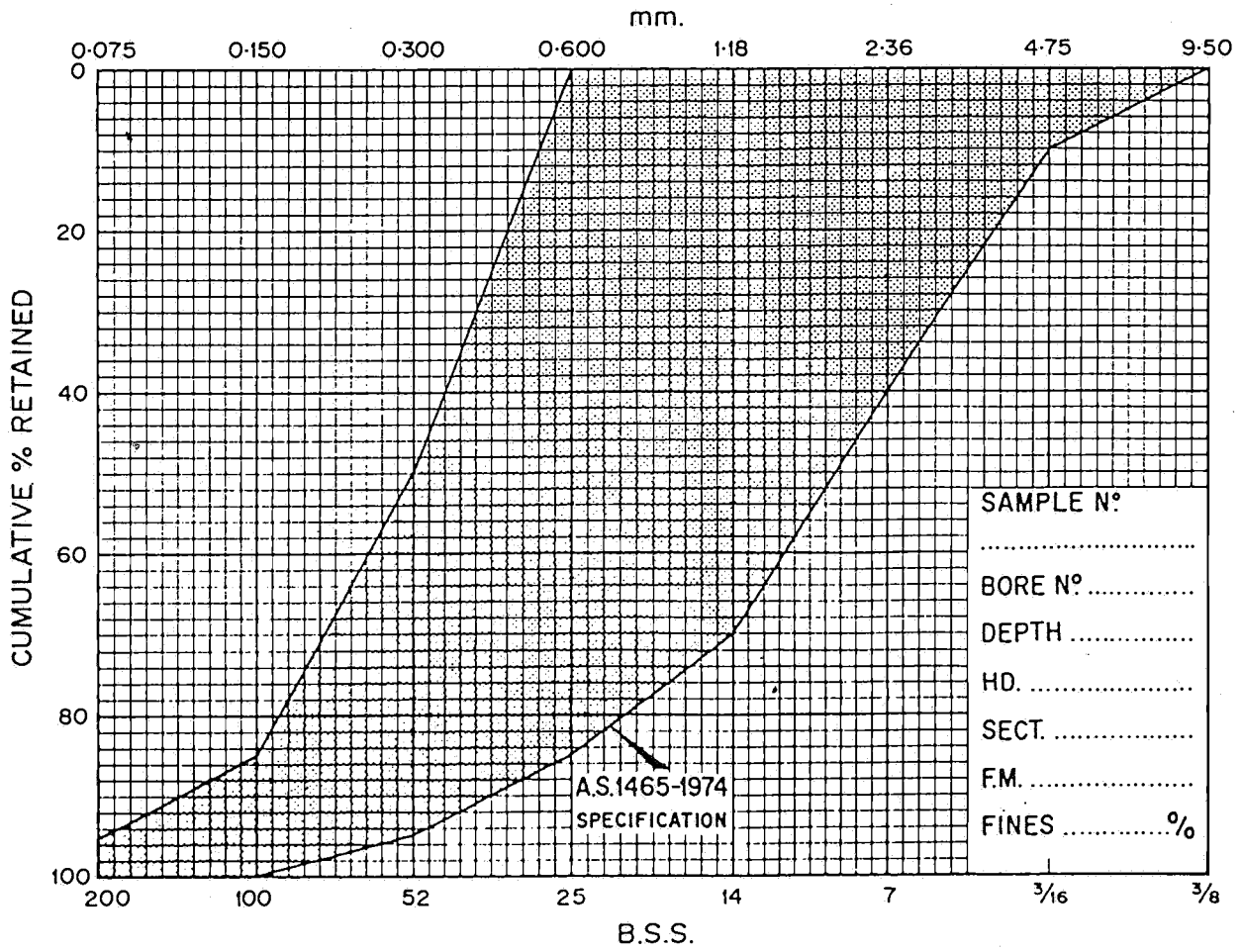
0·150
0·300
0·600
1·18
2·36
4·75
9·50
0
20
40
60
80
100
CUMULATIVE % RETAINED
200
100
52
25
14
7
3/16
3/8
B.S.S.
A.S.1465-1974
SPECIFICATION
SAMPLE N°
15
BORE N°
DEPTH
HD.
SECT.
F.M. 1·23
FINES 4·4 %


mm.
0·075
0·150
0·300
0·600
1·18
2·36
4·75
9·50
0
20
40
60
80
100
CUMULATIVE % RETAINED
200
100
52
25
14
7
3/16
3/8
B.S.S.
A.S.1465-1974
SPECIFICATION
SAMPLE N°
16
BORE N°
DEPTH
HD.
SECT.
F.M. 2·30
FINES 9·8 %


0·075
0·150
0·300
0·600
1·18
2·36
4·75
9·50
0
20
40
60
80
100
CUMULATIVE % RETAINED
200
100
52
25
14
7
3/16
3/8
B.S.S.
A.S.1465-1974
SPECIFICATION
SAMPLE N°
17
BORE N°
DEPTH
HD.
SECT.
F.M. 2·59
FINES 10·9 %


mm.
0·075
0·150
0·300
0·600
1·18
2·36
4·75
9·50
0
20
40
60
80
100
CUMULATIVE % RETAINED
200
100
52
25
14
7
3/16
3/8
B.S.S.
A.S.1465-1974
SPECIFICATION
SAMPLE N°
118
BORE N°
DEPTH
HD.
SECT.
F.M. 5·11
FINES 22·8 %


0·075
0·150
0·300
0·600
1·18
2·36
4·75
9·50
0
20
40
60
80
100
CUMULATIVE % RETAINED
200
100
52
25
14
7
3/16
3/8
B.S.S.
A.S.1465-1974
SPECIFICATION
SAMPLE N°
19
BORE N°
DEPTH
HD.
SECT.
F.M. 3·08
FINES 3·3 %


mm.
0·075
0·150
0·300
0·600
1·18
2·36
4·75
9·50
0
20
40
60
80
100
CUMULATIVE % RETAINED
200
100
52
25
14
7
3/16
3/8
B.S.S.
A.S.1465-1974
SPECIFICATION
SAMPLE N°
BORE N°
DEPTH
HD.
SECT.
F.M.
FINES %

APPENDIX B

FOUNDRY AND GLASS SAND TESTING

EXTRACTED FROM AMDEL REPORT M1702/91

by

Robert J. Allen

1. INTRODUCTION

Mr D C Scott, of the South Australian Department of Mines and Energy, submitted to Amdel Limited three silica sands for assessment of suitability for foundry use, or for the glass industry.

2. PROCEDURE

The sands as received were riffled to provide representative subsamples for chemical analysis, microscopic examination, and particle sizing.

2.1 Chemical Analysis

The sand samples were subjected to 'whole rock' analysis by ICP (induction coupled plasma) emission spectroscopy, using the standard Amdel Limited routine. The total organic carbon and carbonate contents of the samples were determined by ignition methods, with gravimetric determination of carbon dioxide absorbed on soda asbestos.

2.2 Microscopic Examination

The samples were examined under a stereo binocular microscope.

2.3 Sizing Analysis

The particle size distributions were determined in accordance with procedures specified by the American Foundrymen's Society (1963).*

3. RESULTS

3.1 Chemical Analysis

The results of the chemical analyses are presented in Table 1.

3.2 Microscopic Examination

The full mineragraphic descriptions are included as Appendix A.

3.3 Sizing Analysis

The sieve sizing results are presented in Tables 2 to 4. Size frequency and cumulative curves drawn on log.log graph paper are included as Figures 1 to 3.

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* American Foundrymen's Society (1963) "Foundry Sand Handbook" Seventh Edition, pp 5-2 to 5-5.

4. DISCUSSION

The silica content of the three sands is well below that required for the glass industry (98.5% SiO_2 min) and the iron content far exceeds the maximum limit of 0.03%. The major impurity elements are aluminium and potassium, suggesting the presence of a potassium aluminium silicate mineral (e.g. microcline feldspar).

The high content of alkalis would probably preclude the use of these sands as foundry sands, unless some inexpensive physical method of benefication could be found; a more extensive mineralogical investigation, including X-ray diffraction, would be required to identify the impurity mineral(s) and to investigate distribution and liberation. The contents of carbonate and organic matter were negligible.

Although containing little ~53μm material ('silt'), the sands are poorly sorted, having very broad particle size distributions. The AFS grain fineness numbers were 66 for sample RS 521 and 52-53 for the other two samples.

TABLE 1 CHEMICAL COMPOSITION OF THREE SAND SAMPLES

Component	Weight Percent in Sample No. RS 521	RS 522	RS 523
SiO_2	89.8	84.6	86.7
TiO_2	0.21	0.09	0.14
Al_2O_3	5.05	7.40	6.50
Fe_2O_3*	0.46	0.73	0.58
MnO	<0.01	<0.01	<0.01
MgO	0.06	0.08	0.05
CaO	0.15	0.21	0.18
Na_2O	0.31	0.72	0.59
K_2O	3.36	4.36	4.28
P_2O_5	<0.01	<0.01	<0.01
LOI**	0.54	0.97	0.62
TOTALS	99.9	99.1	99.6
CO_2	<0.05	<0.05	<0.05
TOC***	0.07	0.04	0.05

* Total iron as Fe_2O_3

** LOI = Loss on Ignition

*** TOC = Total Organic Carbon

TABLE 2 SCREEN SIZE DISTRIBUTION OF SAMPLE RS 251

Sample Weight = 466.6g

Total % Sand Grade = 97.4

AFS Clay (Average) = 2.6

AFS Grain Fineness No. = 66

Nominal Size, μm	US Series No (ASTM)	Equivalent Mesh BSS	Weight, g Retained	Percent Retained	Cumulative % Retained
850	20	18	9.60	2.06	2.1
600	30	25	38.90	8.34	10.4
425	40	36	84.58	18.13	28.5
300	50	52	68.12	14.60	43.1
212	70	72	85.59	18.34	61.5
150	100	100	68.18	14.61	76.1
106	140	150	57.96	12.42	88.5
75	200	200	32.74	7.02	95.5
53	270	300	8.63	1.85	97.4
-53	-270	-300			100.0

TABLE 3 SCREEN SIZE DISTRIBUTION OF SAMPLE RS 252

Sample Weight = 444.90g

Total % Sand Grade = 97.3

AFS Clay (Average) = 2.7

AFS Grain Fineness No. = 53

Nominal Size, μm	US Series No (ASTM)	Equivalent Mesh BSS	Weight, g Retained	Percent Retained	Cumulative % Retained
850	20	18	10.78	2.42	2.4
600	30	25	49.31	11.08	13.5
425	40	36	116.83	26.26	39.8
300	50	52	95.60	21.49	61.3
212	70	72	83.18	18.70	80.0
150	100	100	39.66	8.91	88.9
106	140	150	23.20	5.21	94.1
75	200	200	10.76	2.42	96.5
53	270	300	3.76	0.85	97.3
-53	-270	-300			100.0

TABLE 4 SCREEN SIZE DISTRIBUTION OF SAMPLE RS 253

Sample Weight = 430.70g

Total % Sand Grade = 98.9

AFS Clay (Average) = 1.1

AFS Grain Fineness No. = 52

Nominal Size, μm	US Series No (ASTM)	Equivalent Mesh BSS	Weight, g Retained	Percent Retained	Cumulative % Retained
850	20	18	6.98	1.62	1.6
600	30	25	46.46	10.79	12.4
425	40	36	103.38	24.00	36.4
300	50	52	86.96	20.19	56.6
212	70	72	91.03	21.14	77.7
150	100	100	44.10	10.24	88.0
106	140	150	27.80	6.45	94.4
75	200	200	14.55	3.38	97.8
53	270	300	4.47	1.04	98.9
-53	-270	-300			100.0

al.

APPENDIX A BRIEF MINERALOGICAL DESCRIPTION OF THREE SAND SAMPLES

Sample No.	Colour	Shape	Morphological Description	Heavy Minerals
RS 251	Light-brown	Angular to Subangular	Poorly sorted, unconsolidated quartz sand with minor iron-staining, ranging from colourless, glassy grains to white and brown opaque "sugary" grains. Non-calcareous, with minor organic debris. Iron-staining concentrated in the coarser "sugary" fractured grains.	Trace
RS 252	Brown	Angular to Subangular	Poorly sorted, unconsolidated quartz sand with moderate iron-staining affecting the majority of particles, but concentrated in the numerous "sugary" fractured grains present. Non-calcareous. Traces of organic debris present.	Trace
RS 253	Pale-brown	Angular to Subangular	Poorly sorted, unconsolidated quartz sand with minor iron-staining, which is concentrated in the coarser, "sugary", fractured particles. Non-calcareous, with traces of organic debris. Very similar to RS 251 above.	Trace

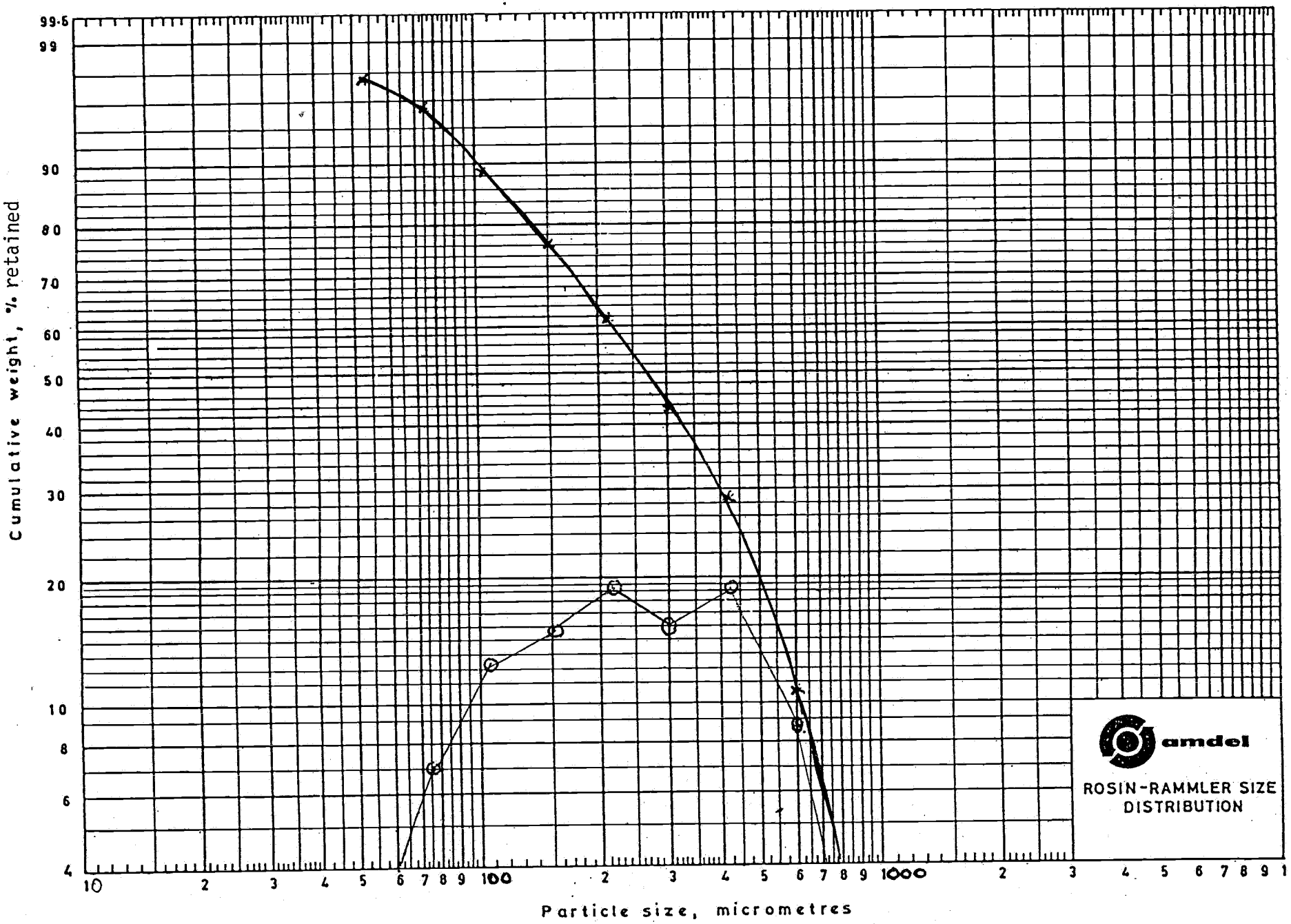


FIGURE 1: PARTICLE SIZE DISTRIBUTION OF RS 251.

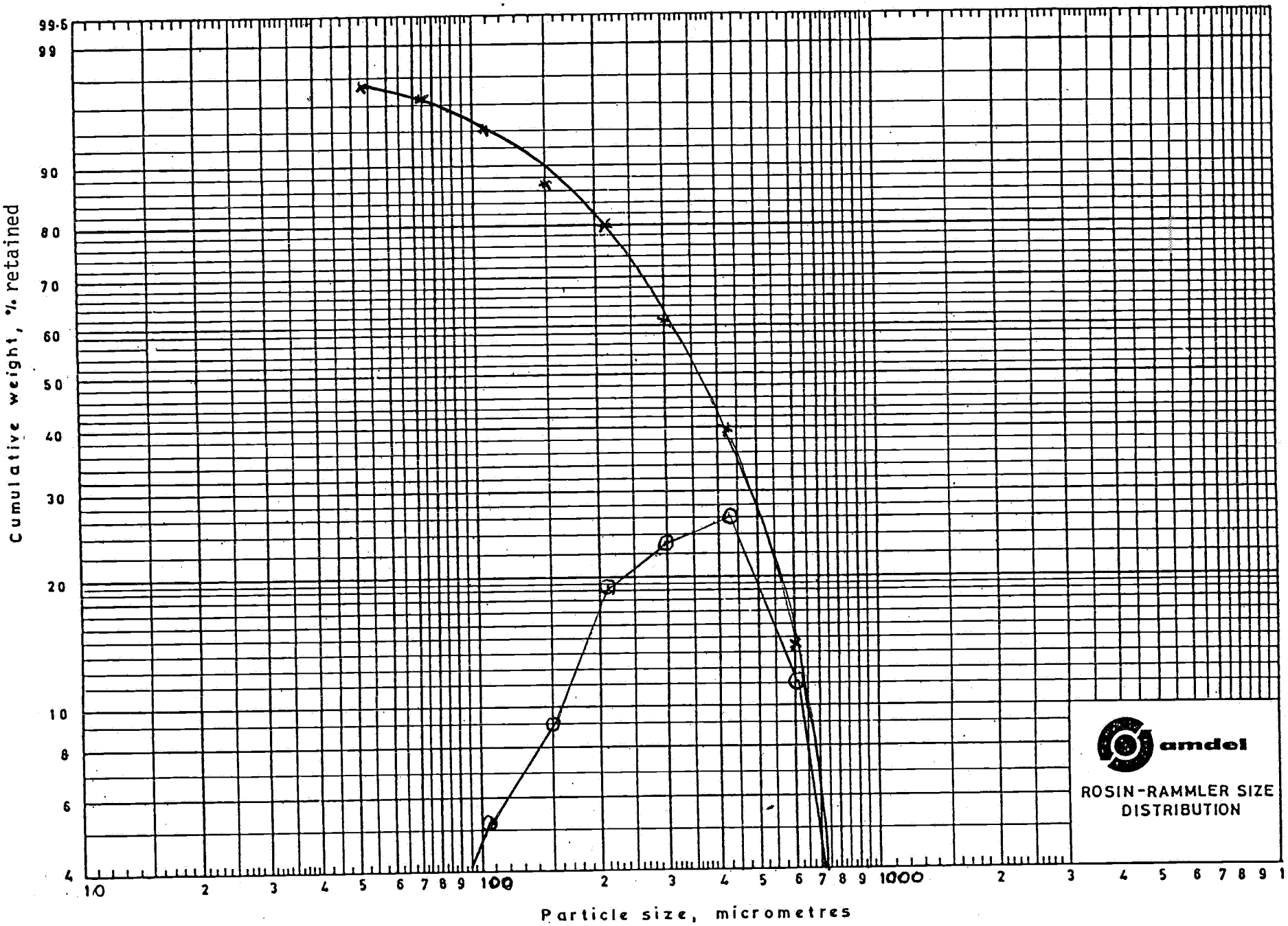
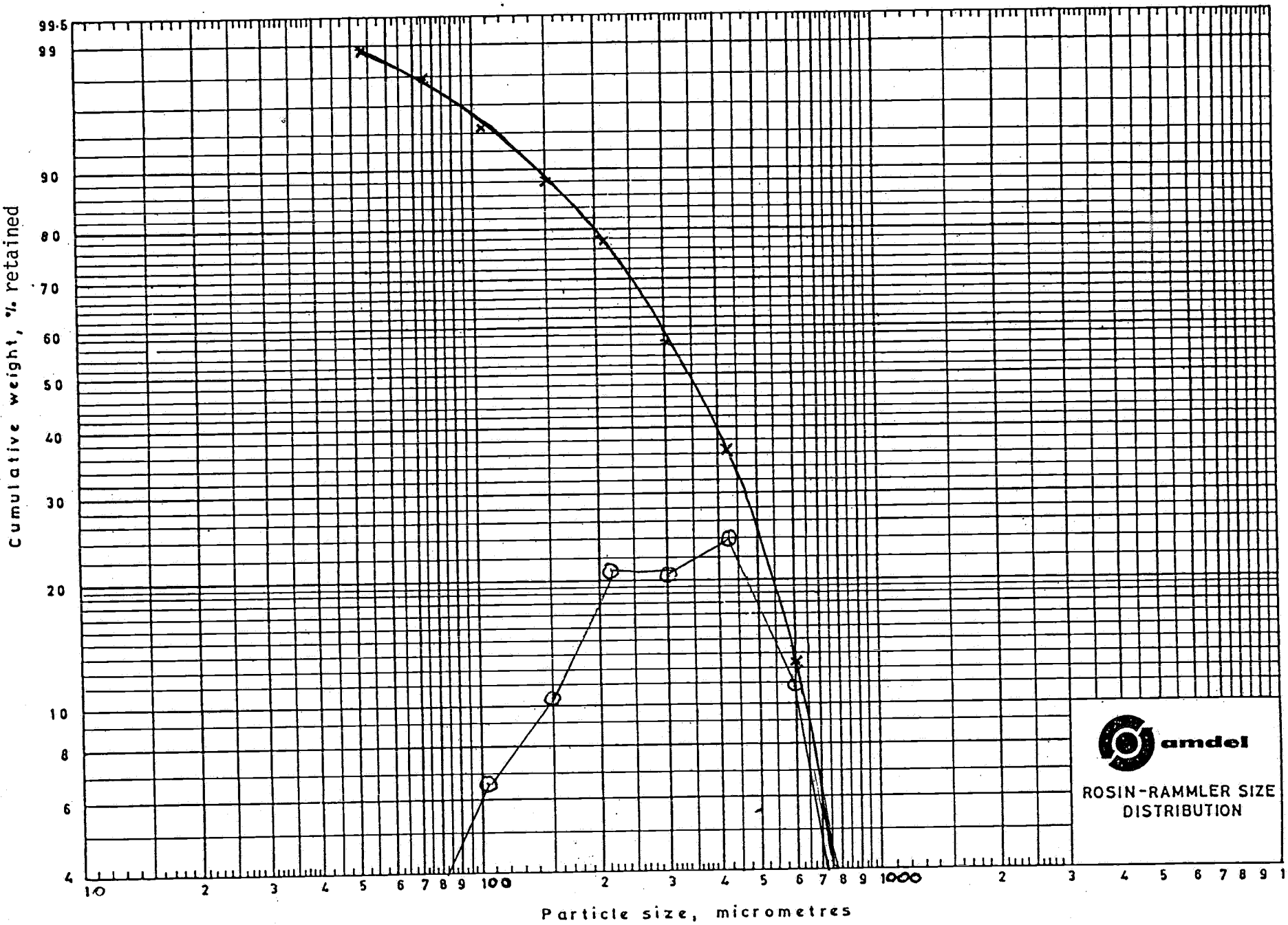


FIGURE 2: PARTICLE SIZE DISTRIBUTION OF RS 252.



PIGURE 3: PARTICLE SIZE DISTRIBUTION OF RS 253.

APPENDIX C

LOGS OF SELECTED HOLES

BORE GENERAL FILE

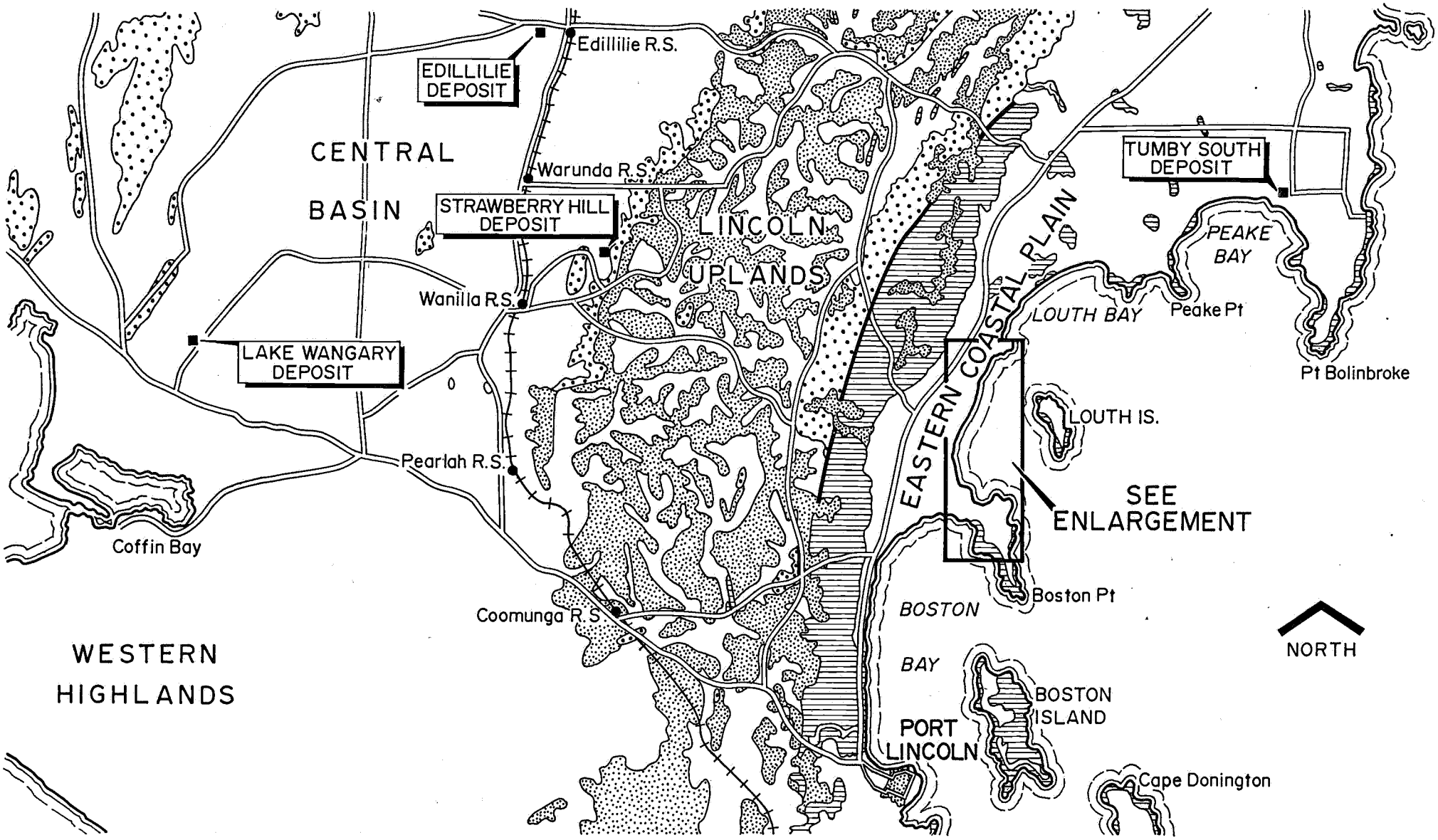
SHEET 6028-IV

Abbreviations used:

VF	Very fine
M	Medium
C	Coarse
EoH	End of hole
SL	Static level of water

Hole No.	Depth (m) From	To		Description
1181	0.0	6.4	Clay	- Red brown with some gravel
	6.4	15.8	Sand	- M-C. Some F Gravel. Yellow-grey
	15.8	18.3		- As above. Pale grey
	18.3	18.9		- As above. Brown-grey
	18.9	EoH		
	SL	12.2		
1188	0.0	2.7	Clay	- Brown, lateritic
	2.7	9.1	Sand	- F-M. Abundant gravel. Light yellow
	9.1	14.0		- F-M. Sl clayey. Yellow
	14.0	14.3		- F-C. Abundant gravel
	14.3	EoH		
	Sl	7.9		
1200	0.0	4.3	Clay	- Brown, yellow. Some gravel
	4.3	9.1		- Sandy, pink. Some gravel
	9.1	19.8	Sand	- C. Abundant quartz gravel. Grey
	19.8	EoH		
	Sl	15.2		
1206	0.0	2.7	Clay	- Brown and yellow
	2.7	4.6	Sand	- Pink, clayey
	4.6	8.5		- F-C. white and pink. Angular
	8.5	26.2	Clay	- White
	26.2	46.9	Sand	- Mainly F, some C bands. Grey and white
	46.9	47.2	Gneiss	
	47.2	EoH		
	SL	13.4		
1238	0.0	2.4	Grit	- F-C. clayey. Yellow
	2.4	4.6	Clay	- White, Sandy
	4.6	23.2	Schist	
	23.2	EoH		
	SL	7.9		
1241	0.0	5.8	Sand	- F white-yellow. Clayey
	5.8	6.7		- F-M. Pale yellow. Clayey
	6.7	11.8		- M White. Micaceous
	11.8	13.1	Gneiss	
	13.1	EoH		
	SL	Dry hole		
1244	0.0	6.7	Clay	- Orange. Sandy
	6.7	18.9	Sand	- F-M. Buff. Clayey
	18.9	21.3		- F Red
	21.3	34.7	Clay	- Buff, sandy
	34.7	EoH		
	SL	28.0		

1246	0.0	0.5	Gravel	- Iron stone
	0.5	3.0	Clay	- Yellow-red. Lateritic
	3.0	7.3	Grit	- C. Pale brown. Clayey
	7.3	13.4	Quartzite	
	13.4	EoH		
	SL	9.8		
1248	0.0	9.8	Sand	- Brown. Clayey
	9.8	13.1	Gravel	- F-M.
	13.1	13.3	Granite(?)	
	13.3	EoH		
	SL	9.8		
1250	0.0	0.9	Grit	- C. Minor clay
	0.9	10.4		- C with yellow-brown clay
	10.4	12.2	Clay	- Blue-grey, gritty
	12.2	18.3	Quartzite	
	18.3	EoH		
	SL	9.1		
1251	0.0	2.4	Clay	- Yellow, sandy with laterite
	2.4	12.2	Sand	- F-M. Offwhite with grit
	12.2	21.6	Clay	- Yellow with F quartz gravel
	21.6	EoH		
	SL	12.2		
1253	0.0	2.1	Clay	- Brown, sandy lateritic
	2.1	4.6	Sand	- M-C. White
	4.6	28.7	Schist	- Weathered to 18.3
	28.7	EoH		
	SL	Dry		
1273	0.0	0.3	Soil	
	0.3	2.1	Sand	- F-C.
	2.1	8.5	Clay	- Yellow brown & grey. Sandy with some grit
	8.5	10.1	Bedrock	
	10.1	EoH		
	SL	3.5		



CONSTRUCTION SAND DEPOSITS - PORT LINCOLN AREA
LOCATION AND REGIONAL GEOLOGY

FIG. 1

5281

LOUTH BAY

Highway

Lincoln

EML 3082

Sec. 258

EML 3081

Sec. 257

Sec. 277

EML 5359

Sec. 130

EML 3203

Sec. 124

HD OF

EML 3245

Sec. 453

LOUTH

Sec. 122

Sec. 457

Sec. 120

EML 3204
(cancelled)

Sec. 112

MC 2588

Sec. 111

EML 3205
(cancelled)

Sec. 110

Sec. 109

N

Beach Ridge deposits of St Kilda Formation.

Aeolian deposits of fine Moornaba Sand.

Mining Tenements
EML : Extractive Mineral Lease
MC : Mineral Claim.

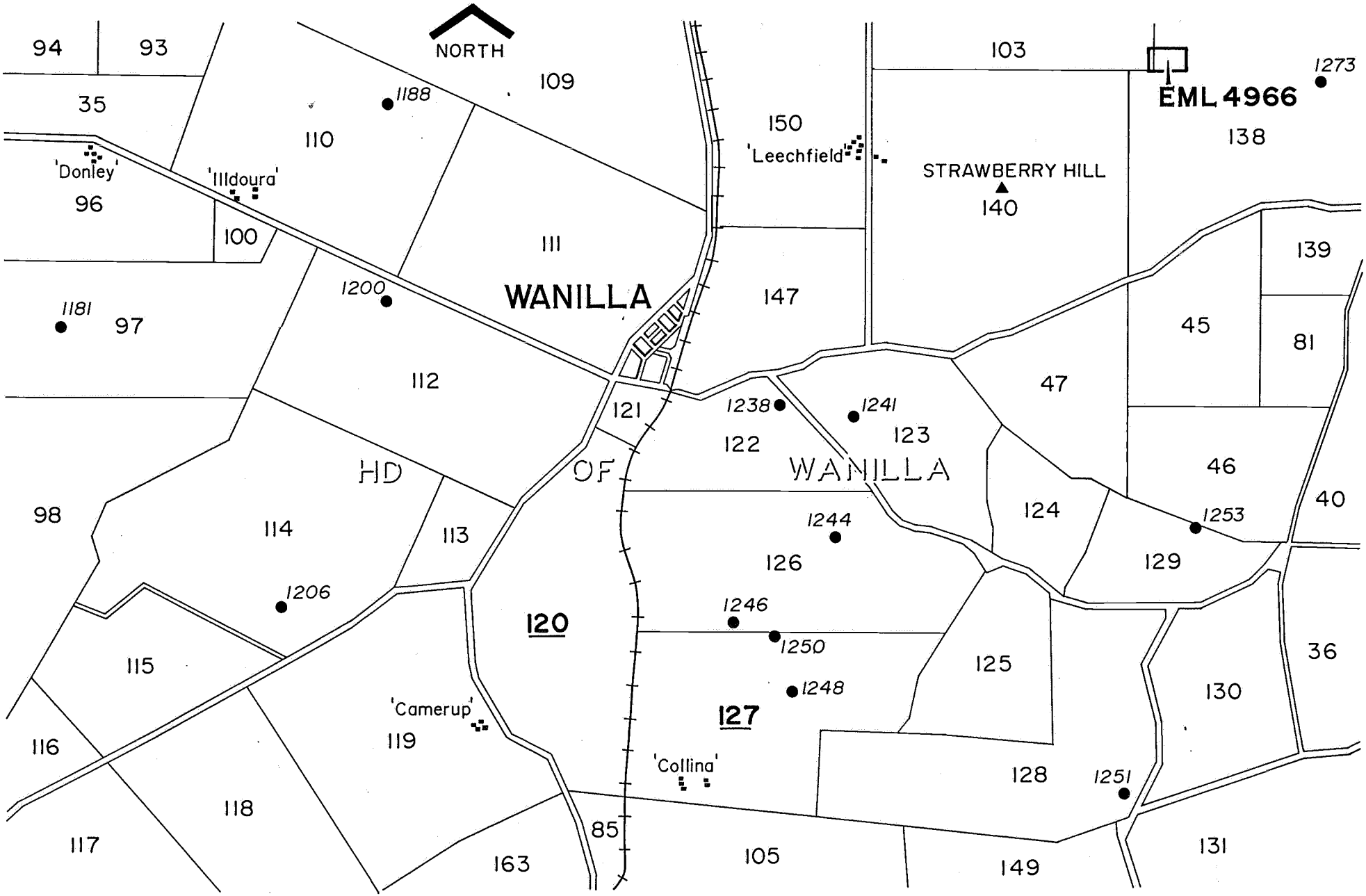
Sand pit.

Sand sample location.

0 400 800 1200 1600 2000
METRES

CONSTRUCTION SAND DEPOSITS-PORT LINCOLN AREA
LOCATION OF MINING TENEMENTS
AND SAND PITS

FIG. 2
SADME 91-312



CONSTRUCTION SAND DEPOSITS—PORT LINCOLN AREA

BOREHOLE LOCATION PLAN

WANILLA-STRAWBERRY HILL FIG. 3

SADME S22209