DEPARTMENT OF MINES SOUTH AUSTRALIA

GEOLOGICAL SURVEY ENVIRONMENT AND RESOURCE DIVISION

TEPKO SAND DEPOSIT
Sections 107 & 110 Hundred of Finnis

Concrete Industries (Monier) Limited.

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Extractive Minerals Section

Rept.Bk.No. 75/10 G.S. No. 5550 D.M. No. 76/75 76ンにも

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74-1007	Monarto Construction Sand Investigation. Tepko Sand Deposit. Sections 107,110 Hd. Finnis. Geology and Drill-Hole Locations		1:1000	
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TEPKO SAND DEPOSIT

Sections 107 & 110 Hundred of Finnis Concrete Industries (Monier) Limited.

ABSTRACT

Coarse sands and gravels equivalent to the Parilla Sand Formation outcrop in road and rail cuttings 4 km north of Tepko railway station.

Detailed auger drilling in sections 107 & 110 Hundred of Finnis indicated 464000 cubic metres of coarse construction sand and 187000 cubic metres of fine construction sand are overlain by 124000 cubic metres of overburden.

82 000 cubic metres of coarse sand and 13 000 cubic metres of fine sand occur beneath a road which crosses the deposit. It is recommended that approval to entract this material be sought from the appropriate Authorities.

Sieve sizing analyses and petrographic examinations have shown this material to be suitable for construction purposes.

INTRODUCTION

The proposed new city of Monarto with a possible population of 250 000 is to be built near Murray Bridge west of the River Murray.

Estimated construction sand requirements are 14 million cubic metres within 20 years of the commencement of building, of which 3 million will be required during the first 5 years

(data provided by the Monarto Commission)

Firman and Rogers (1972) provide preliminary data on construction materials, and Nichol (1974) summarises the resource potential of the area. The work described in this report was carried out on behalf of Concrete Industries (Monier) Ltd as a service attached to the hire of a Departmental drilling plant. The area was selected by the Company, who are negotiating a Private Mine agreement with the freehold landowners.

GEOLOGICAL SETTING

The regional geology is shown on Mobilong (Johns, 1960) and Mannum (White and Thatcher, 1957) from which the geology shown on plan S11137 is compiled.

Nichol (1974) has detailed age, lithology, thickness, stratigraphic relationships and potential use of rock units in the area, and his table (plan 74-236) is reproduced in this report.

The Monarto region comprises two distinctive physiographic units; the Eastern Mount Lofty Ranges consisting of folded Lower Palaeozoic schists, migmatites and granites, and the Murray Basin containing younger, flatlying sediments of Tertiary to Quaternary age. These contrasting rock suites have different lithological and physical properties, and are confined to topographically well defined portions of the area except in a marginal zone where the Murray Basin sediments overlap the older rocks of the ranges. Most of the work described in this report was carried out in the marginal zone.

AGE	ROCK UNIT	LITHOLOGY	THICK -NESS	STRATIGRAPHIC RELATIONSHIPS	REMARKS	POTENT
		Alluvial gravels, sands and clays.	Variable, but up to about 5m	Deposits of modern streams; not differentiated.		Sand
RECENT	COONAMBIDGAL FORMATION	Clays, silts and sands.	About 15m	Deposits of modern streams; not differentiated.	Upper valley fill. Restricted to riverine deposits with geomorphic expression in the Murray River tract and adjacent stranded deposits once connected.	Sand and
	MOLINEAUX SAND	Yellow guartz sand.	About 6-9m In dunes	Stratigraphic position similar to Bunyip Sand.	Longitudinal dunestrending west reast and north- west resoutheast, and as parabolic dunes.	
	BUNYIP SAND	Light red brown quartz sand,	Variable, but up to about 5m in dunes	Stratigraphic position similar to Molineaux Sand	Dunes or as a veneer on older units.	Sand
UPPER	CALLABONNA CLAY	Red-brown sandy clay and clayey sand	Up to Im	Overlies Pooraka Formation.		
PLEISTOCENE	POORAKA FORMATION	Clayey sands, sands and gravels containing carbonate of the LOVEDAY SOIL.	About 5m	Occupying stream channels incised through older materials on the flanks of the ranges.	Colluvial and alluvial material.	Clay
MIDDLE	BAKARA SOIL	Fossil soil. Hard massive, nodular and sheet calcrete. RIPON CALCRETE at base in many places.	About 2m			Rock filling and aggregate
PLEISTOCENE	BRIDGEWATER FORMATION	Medium to coarse-grained calcarenites with varying proportions of quartz.	About 15m	Stranded coastal dunes, beach ridges and beach deposits.		
LOWER PLEISTOCENE	BLANCHETOWN CLAY	Greenish-grey and red-brown and green mottled sandy clay.	Up to about 20m	Overlies late Pliocene deposits and other Tertiary sediments.		Clay
UPPER	NORWEST BEND FORMATION	Pale grey, brown and yellow quartz sand, calcareous, fossiliferous in places and containing oyster beds which characterise the formation	About 6m	Overlies Mannum Formation. Overlain by Pleistocene to Recent deposits, mainly Blanchetown Clay.	In the Murray River tract between Monteith and Tailem Bend.	
PLIOCENE	PARILLA SAND	Grey, pale brown and yellow fine to medium grained clayey quartz sand with thin beds of olive sandy clay near the top.	Up to 15m	Grades laterally into Norwest Bend Formation near Kingston-on-Murray and is equivalent in part to that formation.		
UPPER PLIOCENE?	UNNAMED	White quaritz sand, pebbly conglomerate and sandy	Not known	Probably equivalent to Parilla Sand.	Tepko area.	Sand
LOWER PLIOCENE	LOXTON SANDS	Pale yellow fine grained sand and micaceous clayey sand.	Up to 10m	Overlies Mannum Formation, overlain by Pleisto- -cene to Recent deposits mainly BlanchetownClay.	Can be traced in the Murray River cliffs north of Monteith, widespread in the Murray Basin area of the map.	
LOWER	FINNISS CLAY	Grey-green and brown clays.	1-5m thick	Overlies Mannum Formation with a pronounced unconformity.	+	Clay
MIOCENE	MANNUM FORMATION	Yellow-brown sandy limestone and calcareous sandstone.	About 30m	Overlain by Finniss Clay with a marked unconformity; underlain by Ettrick Formation and Compton Conglomerate.	Transgressive onto Kanmantoo Group rocks.	Coarse aggregate building stone
OLIGOCENE	ETTRICK FORMATION	Glauconitic and calcarenitic marls.	About		Crops out at the base of river cliffs near Tailem Bend (Firman and Rogers, 1972).	
	COMPTON CONGLOMERATE	Quartz and ironstone gravel and conglomerate.	3m1	Overlies Kanmantoo Group rocks and underlies Mannum Formation.	Crops out in railway cuttings near 'Kalibar'	_
	MURRAY BRIDGE GRANITE	Coarse grained red-brown granite.		Intrusive; discordant.	Crops out at Sturt Reserve and Swanport.	Aggreaat
ORDOVICIAN	MONARTO GRANITE	Light grey, fine grained gneissic adamellite		Concordant.	Produced by complete granitization of Kanmantoo Group during the Delamerian Orogeny.	Aggregat building stone
	PALMER GRANITE AND RELATED ROCKS	Medium-to coarse grained granodiorite, aplite, adamellite and albitised granite.	_	Intrusive; discordant.		
LOWER CAMBRIAN	KANMANTOO GROUP	Siliceous schists, micaceous quartzites and phyllites with pyritic beds gneisses and migmatites	At least		Regional metamor phism during Delamerian Orogeny	-Aggregat y.

S.A. DEPARTMENT OF MINES

MONARTO PROJECT

TABLE I

STRATIGRAPHIC TABLE SHOWING ECONOMIC MINERALS AND ROCKS

COMPILED BY DINICHOL

In the Tepko area, gravels, sands and clays equated by Nichol (1974) to the Parilla Sand unconformably overlie Lower Palaeozoic migmatites and granites. They in turn are overlain by plastic clays of the Pooraka Formation, calcretes and aeolian "Bunyip Sand".

TEPKO SAND DEPOSIT Drilling

13 holes totalling 102.5 metres were drilled between 29th August and 2nd September, 1974, using a Gemco auger mounted on the tray of a Land Rover utility. A programme of drilling for the Monarto Commission was carried out in conjunction with the project, and additional information from this source is included in the report. Logs of all relevant holes are presented in Appendix I.

General

The deposit is located 4 km north of Tepko railway station in sections 107 and 110 Hundred of Finnis. A geological plan and cross-sections were drawn from a plane table survey (see plans 74-1007 and 74-1008).

To the north of the road, the deposit consists of yellow-orange coarse-grained micaceous sand with low "clay" contents averaging only 11% in the -200 mesh B.S.S. fraction.

Coarse sand is also found south of the road, but most of the material in this section is fine sand with -200 mesh "clay" contents averaging 12.4%.

Microscopic examination has shown the sand to be suitable for concrete aggregate, and petrographic descriptions are given in Appendix III.

Gravel lenses occur within the deposit, and numerous quartz pebbles up to 15 cm in diameter are scattered over the surface of the ground. However, in drilling the deposit the auger pushes the pebbles aside or crushes them so that accurate sampling is not possible.

The sediments were deposited in a fluvio-lacustrine environment on an irregular basement consisting of migmatites and granites from which they were derived. Some idea of the basement topography can be gained from section A-A' (plan 74-1008) where the sand reaches a depth of 10.8 m in hole no. M.C.15, only 80 m from outcropping migmatites.

Contacts between the coarse and fine construction sand, and the waste silt and clay are shown on the cross sections in a schematic, lenticular style. The exact nature of the gradation between the two will become apparent when extraction of sand is commenced. Many of the sieve sizing analyses show a bimodal distribution (ie. two distinct populations of grain sizes are present). It is therefore likely that the sediments were derived from two separate sources, and this local concentration of coarse sand may have been the point of entry of a fast-flowing river channel into a fresh water lake, with finer sediments being deposited elsewhere. In this case, a gradational contact passing from predominantly coarse sand in the north to fine sand in the south of the deposit will be expected.

Some re-working of the upper part of the deposit occurred after deposition, and an accumulation of rounded quartz pebbles is commonly encountered in the top metre of each hole. This was heavily impregnated by white calcrete in Pleistocene times, and together with a thin veneer of Recent and aeolian sand constitutes the overburden.

Calcareous material has also impregnated the upper 3-4 metres of the sand deposit, the quantity decreasing with depth. The carbonate appears to be very fine grained and most would be removed in the washing process (see Appendix III).

SIEVE SIZING ANALYSIS & PETROGRAPHIC EXAMINATION.

Samples from selected drill holes were submitted to AMDEL for petrographic examination (see Appendix III) and for sieve sizing according to A77 specifications (ie. dry and weigh and sieve the +200 mesh fraction).

Fineness modulus values were calculated from sieve sizing data, by expressing cumulative amounts retained on successive sieves as a percentage of the dry +200 mesh fraction. Cumulative percentages retained on the 100, 52, 25, 14, 7, 3/16 and 3/8 B.S.S. sieves are summed and divided by 100. The A77 envelope has a F.M. value of 1.35 for the finest permissible material and 4.00 for the coarsest.

Graphical plots of sieve sizing analyses are shown in Appendix II. Fineness modulus values and "clay" contents (-200 mesh B.S.S.) are shown on the cross-sections (plan 74-1008) and on logs in Appendix I.

Bimodal distributions were obtained from most holes containing coarse construction sand, with low amounts retained

on 52 and 25 mesh B.S.S. sieves.

RESERVE CALCULATIONS

For convenience, the sediments were divided into the following categories, based on fineness modulus figures and "clay" contents.

(a) Coarse Construction Sand: Fineness modulus between 1.35 and 2.00; "clay" content less than 20%.

(b) Fine Construction Sand: Fineness modulus between 2.00 and 4.00; "clay" content less than 20%.

Reserves were calculated from polygonal areas of influence surrounding each drill hole (see Appendix IV). Edges of polygons near the margins of the deposit were inferred from the cross-sections. For the purposes of this calculation, a buffer zone of 5 metres was allowed along the edge of the road, to allow for battering down of the slopes should the material beneath the road be unavailable. It should be noted that reserve estimates of construction sand south of the road are less accurate than those north of the road, due to wider drill-hole spacings: they are probably best regarded as "inferred reserves".

A summary of the data is presented in the table below: detailed calculations may be consulted in Appendix ${\tt IV}_{ullet}$

TABLE II

Reserve Estimates (Cubic metres in situ)

	Section 107 (North of Road)	Road	Section (South of	Total
Overburden	39 000	12 000	72 000	123 000
Coarse Construction Sand	244 000	82 000	138 000	464 000
Fine Construction Sand	1 000	13 000	173 000	187 000
Waste	9 000	6073		9 000

It should be noted that in addition to the reserves quoted above, use could be made of some material which because of its fineness is presently regarded as "waste" or "overburden" (e.g. material intersected in holes CI5, CI6, CI10 & CI11).

Judicious blending of this material could increase reserves by as much as 20%.

CONCLUSIONS AND RECOMMENDATIONS

It is recommended that the Tepko deposit be worked as a single operation. Although some of the fine sand to the south of the road may be suitable for such purposes as plastering sand or brick laying sand, better use would probably be made of the deposit if it could be blended with the coarser material to produce concrete sand.

2. Substantial reserves occur beneath the road which crosses the deposit (see table 2). Operation of the deposit will be easier, and more attractive economically if this material can be extracted. An approach should be made to the appropriate authorities to secure approval. Procedures for this are outlined in the Regulations under the Mining Act, 1971. Section C-C' on plan 74-1008 shows the basement surface in the vicinity of the road to be fairly flat, so that when the operating is complete a level surface will be exposed for the formation of a new road.

The worked-out pit should present no problems in rehabilitation, which will be more effective if the material beneath the road is removed.

3. Clay contents are generally low, and acceptable products could be obtained from possibly one third of the deposit simply by dry-screening. However, because of the relatively high clay contents of much of the very fine material, blending will reduce the volume available for dry-screening.

A supply of water will be necessary for washing operations, and some of this could come from Reedy Creek. Adequate settling dams and flocculants should be used to ensure that there is no unacceptable discharge of silt into the Reedy Creek system.

- 4. Due to the nature of the auger sampling, no estimate could be made of the quantity of gravel present. If quantities are sufficient, it may be feasible to install a small crusher and re-cycle the screen oversize.
- 5. After working of the sand has commenced, samples of slime from the settling dams should be tested to assess suitability of inclusion in a brick clay blend.

GEOLOGIST EXTRACTIVE MINERALS SECTION.

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Appendix I

Logs of Gemco Auger Holes.

HOLE NO CT ! DEPARTMENT OF MINES-SOUTH AUSTRALIA RIG Gemco LOG OF ROTARY DRILL HOLE LAT DEPTH 13.0M LONG PROJECT MONARTO CONSTRUCTION SAND ANGLE Vertical PURPOSE ... To ... PLAN REF. 74-1007 SEC 110 HD Finnis MINERAL SANO AZIMUTH..... D.M. 762/74 REPT. BK.... BORE S/No 911/75 ... ELEV..... DEPTH GRAIN SIZE CLAY: SAND AGE DEPTH SPECIAL COMMENTS LOG DESCRIPTION FORM Brown clayey 5011 Brown gravelly Sondy clay grading Rec. down to sandy quartz gravel. Sondy quartz GRAVEL. FM = 4.07 White and off-white 11.23% Clay Pale orange-brown coarse SAND 3 -10 FM = 2.46 Orange coorse SAND 9.92% Clay. 15 Orange coarse SAND 5-FM = 3.66 Orange very coarse SAND 6.09% Clay -20 Orange coarse SAND grading to yellow-orange silty fine-medium SAND FM = 2.89 Orange COOrse SAND and fine GRAVEL 6.14% Clay 25 Bimodal Orange SAND & fine GRAVEL FM = 2.13 Orange fine-medium SAND. 6.48% Clay. 10 RSI Orange fine-medium SAND 35 FM = 2.32 Orange fine-med SAND grading 6.93% Clay. Bimodal TO COOKSE SAND & FINE GRAVEL. 40 Orange CoarseSAND& FINE GRAVEL /3 13.0m - End of hole. %Clay) GRAIN SIZE CLAY : SAND MOISTURE ENVIRONMENT & RESOURCE (mm) 0 - 5 SA Clean sand DIVISION SC Slightly clayey VF Very fine sand 0.05-0.15 5 - 15Dry DRILL NO. 184 ... LOGGED F Fine sand . 0·15 - 0·25 MC Moderately clayey 15 - 30TYPE Auger. A.M. PAIN 30 - 45M Medium sand 0:25-0:50 VC Very clayey Damp DRILLER A. VON ROAS DATE 26.8.74 **45** – 55 0.50- 1.00 CS Clay sand Coarse sand START 26:8:74. TCD. D.W.W. VC Very coarse sand 1.00-2.00 VS Very sandy 55-70 Wet 🔛 70-85 P Pebbles 2.00-64.00 MS Moderately sandy FINISH . 26 8 74 . CKD. A.F. CO Cobbles 64 00 256 O SS Slightly sandy 85-95 SHEET. /.OF./ DRG.NO. S 11168 CL Clay 95 - 100

P.E. NO. S10323 MG

HOLE NO CZ 2 DEPARTMENT OF MINES-SOUTH AUSTRALIA RIG GEMCO. LOG OF ROTARY DRILL HOLE DEPTH 50m LONG PROJECT MONARTO CONSTRUCTION SAND ANGLE Vertical PURPOSE..T.... PLAN REF 74-1006 SEC //2 HD Finnis AZIMUTH...T.... MINERAL SAND D.M. 762/74 REPT. BK ELEV. T. BORE S/No 911/75 SPECIAL COMMENTS DEPTH DEPTH GRAIN SIZE CLAY: SAND AGE SSA S LOG DESCRIPTION FT. Red-brown acolian SAND Recent stiff red-brown CLAY. Orange-brown to red-brown 5 plastic CLAY PLEISTOCENE 2. Red-brown stiff plastic CLAY 3. -10 Red-brown stiff plastic CLAY. Red-brown, stiff plastic CLAY. 15 5.0m End of Hole. ENVIRONMENT & RESOURCE (%Clay) GRAIN SIZE CLAY : SAND MOISTURE (mm) SA Clean sand 0 - 5 DIVISION VF Very fine sand 0.05-0.15 SC Slightly clayey 5 - 15Dry DRILL NO. 184 LOGGED MC Moderately clayey F Fine sand 0.15 - 0.25 15 - 30A.M. Pain. TYPE AUger Damp 0.25-0.50 VC Very clayey 30 - 45M Medium sand DRILLERA Van Rens DATE 29.8.74 45 - 55 0.50-1:00 CS Clay sand C Coarse sand TCD DWW. START 29.8 74 55-70 VC Very coarse sand 1.00-2.00 VS Very sandy Wet 🖸 70-85 FINISH 29 8:74 CKD. A.F. 2 00 - 64 00 MS Moderately sandy P Pebbles 85-95 64 00-256 0 SS Slightly sandy CO Cobbles SHEET ! OF! DRG.NO. SIII69 CL Clay 95 - 100

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P Pet	oble	s	2.00-64.00	MS	Moderat	ely san	dy	55 - 70 -	85	Wet	:			29·8·		CKD. A.	
CO Col	ololo	25	64-00-256-0		Slightly Clay	sandy		85- 95-				SHE	ET.	.OF. / .	DRG.	10. SIII.7	71

HOLE NO CI 5 DEPARTMENT OF MINES-SOUTH AUSTRALIA RIG Gemco ROTARY DRILL HOLE LOG OF LONG DEPTH 10.0 m PROJECT MONARTO CONSTRUCTION SAND PURPOSE . . . T. ANGLE Vertical PLAN REF. 74-1007 SEC 110 HD FINNIS MINERAL Sand AZIMUTH..... BORE S/No 911/75 D.M. 762/74 REPT. BK.... ELEV.... LOG DEPTH GRAIN SIZE CLAY: SAND AGE SPECIAL COMMENTS DEPTH DESCRIPTION FORM =-= Orange-brown silty SOIL Pleist -with calcareous staining Orange-brown micoceous F.M. = 2.31 5 fine SAND -slightly calcareous 26.90% Clay Pale orange-brown sandy SILT. slightly calcareous -10 Orange-brown fine SAND F.M. = 1.10 slightly calcareous. 26.29% Clay. Orange fine SAND 15 Orange SAND F.M. = 1.33 20 30.38% Clay. Orange SAND F.M. = 1.51 Orange SAND 25 19.67% Clay. Bimodal. Orange SAND 30 F.M. = 2.30 Orange SAND 14.80% Clay Binodol Some pubbles at base of interval 10.0m End of hole. Hole stopped by coarse grave/ GRAIN SIZE CLAY : SAND %Clay) (mm)MOISTURE ENVIRONMENT & RESOURCE SA Clean sand 0 - 5 DIVISION 5 - 15 VF Very fine sand 0.05-0.15 SC Slightly clayey Dry DRILL NO. 184 LOGGED 15 - 30 0.15 - 0.25 Fine sand MC Moderately clayey TYPE Auger A.M. Pain М Medium sand 0.25-0.50 30 - 45 VC Very clayey Damp DATE 29.8.74 DRILLER A Van Rens C Coarse sand 0.50- 1.00 CS Clay sand 45-55 VC Very coarse sand 100-200 START. 29.8.74 TCD DWW. VS Very sandy 55-70 Wet :: P Pebbles 2.00-64.00 Ms Moderately sandy 70-85 FINISH 29.8.74 CKD. A.F. CO Cobbles 64-00-256-0 SS Slightly sandy 85-95 SHEET ! OF! DRG.NO. SII172 CL Clay 95 - 100

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PURP MINE BORE	OS RA S/	- E. – L <i>Sand</i> 'No <i>911/7</i>	•••• •••• •••	LO PR PL	ARTMENT G OF OJECT M AN REF 74 M. 762/7	ROTA ONARI	ARY FO. CO SEC. 1	DI ONST	RUCT	H	OLE	•	RIG DEPT ANG AZIN	E NO <i>CI</i> ? <i>Gemco</i> TH <i>9.0m</i> LE <i>Vertic</i> MUTH - V -	ol
AGE FORM!	CLASS	DE	SCRIPTIO	NC		LOG	DEPTI	GRAII	N SIZE کے کو	CL/	ဦးလုံလ်စ (A : 2 ∀	₹«-	SPECIAL	COMMENTS	DEPT
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AGE FORM	CLASS	DES	CRIPTION	7		LOG	DEPTH m	GR. ⅓ ⊬	AIN S ≤o≤	IZE ⊰∝8	CL S S	YA. ‱	SA SS	ND SS	SPE	CIAL C	OMMENTS	DEPTH FT.
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	ine sand 0.15-0.25 MC Moder vc Very 0.25-0.50 CS Clay 2ry coarse sand 1.00-2.00 VS Very								- 70 - 85	We	t [8·74 8·74	TCD PA	
	ery coarse sand 1:00-2:00 VS Very blobles 2:00-64:00 MS Mode blobles 64:00-256:0 SS Slight				Slightly		•	85-	- 95 - 100			}					NO. S 111	

PF NO 510323 MG

HOLE NO CI 10 DEPARTMENT OF MINES-SOUTH AUSTRALIA RIG Gemco LAT LOG OF ROTARY DRILL HOLE DEPTH 13.0 M LONG PROJECT MONARTO CONSTRUCTION SAND ANGLE Vertical PURPOSE PLAN REF. 74-1007 SEC 110 HD FINNIS MINERAL SAND AZIMUTH. . . D.M. 762/74 REPT. BK BORE S/No 911/75 ELEV..... SPECIAL COMMENTS DEPTH AGE SSY TO DEPTH GRAIN SIZE CLAY: SAND DESCRIPTION Red-brown acolean SAND Recent F.M. = 0-95 Pale brown calcareous SAND 5 28.34% Clay Pale brown st calcareous SAND FM. =1.03 Pale brown sl.calcareous SAND 32.75% Clay Pale brown sl. calcareous SAND 15 Pale brown micaceous SAND F.M. = 1.86 البلاز فيوا البيد البلدة فيزاد بلاية أبيدا فالتراد 20 16.19% Clay Pale brown micaceous SAND F.M. = 1.81 Orange micaceous SAND 12.05% Clay -25 8-F.M. = 1.70 Orange Micaceous SAND 12.63% Clay .30 Orange micaceous SAND 10 F.M. = 1.15 Pole yellow-orange SAND 12.51% Clay 35 WASTE Pale yellow-orange SAND 12 -40 F.M. = 0.94 Pale yellow-orange SAND 19.69% Clay 13.0m End of hole Hole stopped as no more auger flights were available %Clay) GRAIN SIZE CLAY : SAND MOISTURE ENVIRONMENT & RESOURCE SA Clean sand 0 - 5 DIVISION Dry I VF Very fine sand 0.05-0.15 SC Slightly clayey 5 - 15 DRILL NO. 184 0.15 - 0.25 MC Moderately clayey 15 - 30F Fine sand TYPE Auger A.M. PAIN 0.25-0.50 VC Very clayey 30-45 M Medium sand Damp 2 DRILLERA Van Rens DATH 30-8-74 Coarse sand 45 - 55 0.50- 1.00 CS Clay sand TCU DW.W. START 30.8.74 VC Very coarse sand 1.00-200 VS Very sandy 55-70 Wet 🖸 70-85 FINISH .30.8.74. P Pebbles 2.00-64.00 MS Moderately sandy CKD R.F. 64.00-256.0 CO Cobbles 85-95 SS Slightly sandy SHEET / OF / DRG. NO. S 11177 95 - 100 CL Clay

P.F. NO S10323 MG

HOLE NO CI // DEPARTMENT OF MINES-SOUTH AUSTRALIA LOG OF ROTARY DRILL HOLE RIG Gemco LAT DEPTH . 17.0 M. LONG T. ... PROJECT MONARTO CONSTRUCTION SAND ANGLE Vertical PURPOSE MINERAL SAND PLAN REF. 74-1007 SEC 110 HD. Finnis D.M. 762/74 REPT. BK. BORE S/No 911/75 ... LOG DEPTH GRAIN SIZE CLAY: SAND AGE SSA J DEPTH SPECIAL COMMENTS DESCRIPTION Red-brown acolean SAND Recent Red-brown silty CLAY Pleisto cene Red-brown silty CLAY 5 orange-brown clayey SAND F.M. = 3.13 Orange SAND & GRAVEL 16.62% Clay 3--10 Orange SAND F.M. = 1.81 Pale yellow-orange SAND -15 20.29% Clay Off-white pale yellow SAND F.M. =1.98 Yellow-orange SAND 16 99% Clay Yellow-orange SAND 25 F.M. 2.33 Yellow-orange SAND 11.99% Clay 9-30 Yellow-Orange SAND 10 F.M. = 2.71 yellow-orange SAND 12.07% Clay. 35 11-Yellow-orange SAND 12-40 F.M. = 1.63 yellow-orange SAND 10.65% Clay 13-Orange SAND 45 F.M. = 1.86 Orange SAND 11.95% Clay 15-50 Orange SAND Fine 16 Orange SAND Base 55 Pale brown plastic CLAY (wth'd GNEIS) + ++ ment 17.0m End of hole. ENVIRONMENT & RESOURCE CLAY : SAND %Clay) MOISTURE GRAIN SIZE (mm) SA Clean sand 0 - 5 DIVISION SC Slightly clayey 5 - 15 Dry 0.05-0.15 VF Very fine sand DRILL NO 184 LOGGED MC Moderately clayey 15 - 300.15-0.25 F Fine sand A.M. PAIN TYPE Auger 0.25-0.50 VC Very clayey 30-45 Damp M Medium sand DRILLERA Van Rens DATE 2.9.74 45 - 55 0.50- 1.00 CS Clay sand Coarse sand START 29.74 TCD DWW 55-70 Very coarse sand 100-200 Vs Very sandy Wet 🔃 FINISH 2974 CKD AF 70-85 200-64-00 MS Moderately sandy P Pebbles 64-00-256-0 SS Slightly sandy 85-95 CO Cobbles SHEET / OF / DRG.NO. S.11.178 95-100 CL Clay P.F. NO S10323 MG

HOLE NO CI 12 DEPARTMENT OF MINES-SOUTH AUSTRALIA RIG Gemco ... LAT LOG OF ROTARY DRILL HOLE DEPTH 6:0m LONG PROJECT MONARTO CONSTRUCTION SAND ANGLE Vertical PURPOSE MINERAL Sond PLAN REF.74-1007SEC 110 HD FINNIS AZIMUTH. BORE S/No 911/75 D.M. 762/74 REPT. BK ELEV....T..... LOG DEPTH GRAIN SIZE CLAY: SAND AGE SSY TO SPECIAL COMMENTS DEPTH DESCRIPTION Red-brown geolean SAND Red-brown acolean SAND .5 Red-brown geolean SAND Red-brown aealean SAND Red-brown SAND & Cakrete stains 0:00 deistocene 15 Fine red-brown SAND Fine red-brown SAND 6.0m End of hole (No sample return) GRAIN SIZE CLAY : SAND ENVIRONMENT & RESOURCE %Clay) MOISTURE (mm)0 - 5 SA Clean sand DIVISION Dry VF Very fine sand 0.05-0.15 SC Slightly clayey 5 - 15DRILL NO. 184 LOGGED Fine sand 0.15-0.25 MC Moderately clayey 15 - 30A.M. PAIN TYPE Auger M Medium sand 0.25-0.50 VC Very clayey 30 - 45Damp[2] DRILLERA van Rens DATE 2.9.74 CS Clay sand VS Very sandy

45 - 55

55-70

70-85

85-95

95 - 100

MS Moderately sandy

SS Slightly sandy

CL Clay

Wet 🔃

START . 2.9.74 ...

FINISH . 2:9:74.

SHEET / OF / DRG. NO. S11179

TCD. DWW.

CKD. A.F.

P Pebbles

CO Cobbles

P.F. NO. S10323 MG

Coarse sand

VC Very coarse sand 1:00-2:00

0.50- 1.00

2.00-64.00

64.00-256.0

LON PUR MIN	G POS ER	- SE AL <i>Sand</i> JNO <i>911/75</i>		OG PRO	TMENT OF JECT MO N REF74- 762/74	ROTA DNARTO 1997 SI	RY 0 00 EC //	D NSTI	RII RUC HD	T10	HO N S.	L AA	E		RIG DEP ANG AZII	E NO CI Gemco TH 6 Om LE Vertic MUTH	; cal
AGE FORM	N S	DES	CRIPTION	1		LOG	DEPTH m	GRA	N S کن	ZE م S	CLAY	٠. ز يور	AA?	ານ SS ປ	SPECIAL	COMMEN	rs DEPTH FT.
		Fine red-L	brown aeok	30n	SAND												
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LONG PURP MINE	OSI RAI	- <i>ŞANO</i> No <i>910/75</i>	L	OG PRO PLA	OF NECT MG	ROTA NARTO	CON	D STR	RII VÇT	L	HO SAN	L	E		HOLE NO MC/ RIG GEMCO DEPTH 8:75 m ANGLE Vertico AZIMUTH . T ELEV . T	
AGE FORM!	CLASS	DES	SCRIPTIO			-	DEPTH	GRAI	N S	IZE		/; <u>;</u>	AA E &S	SS J D	CDECIAL COMMENTS	DEPTH FT.
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TERTIARY	SE CONSTRUCTION	orange fi	range fine ine silty fine-medi	 SA.	ND		5			-					5.66% Clay F.M = 1.96 7.46% Clay Simodal F.M = 1.98 7.71% Clay. F.M = 2.31	- <i>15</i>
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PF NO. S10323 MG

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			L <i>5AND</i> No <i>910/7</i>		PL/ D.N	AN REF. 74-	-1006 _S	EC .	<i>110</i> BK	. H		FIN			• • •					
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LONG PURP MINE	 OSE RAI	5ANO No 910/15	L (OG ROL	OF JECT MC N REF 74 770/74	ROTA ONARTO	RY 0 co c //	NS.	RI	LL	H INN	01 ی ی	E		RIG DEPT ANG AZIN	NOMC 3. Gemco TH 1.5 m LE Vertica MUTH T	?/ ?/
AGE FORM!			CRIPTION			LOG	DEPTH	GR	AIN S	SIZE	CL	AY:	SA	ND S S J	apeciu.	COMMENTS	DEPTH
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PF NO S	032	3 MG		<u> </u>	y								Щ.				

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LOI PUI MIN	NG RPOS NERA	E L <i>SANO</i> /No <i>910/7</i>		LO PR PL	G OF ROJECT M AN REF. 74 M. 770 / 74	ROTA ONARI -1006 S	ARY O CON	DR STRO	ILL H	IOLE SAND VIS	RIG . DEPT ANGL AZIM	Gemco H 4:0m E Vertica UTH -	
AGE	cl Ass	D	ESCRIPTION			_				AY: SAND		COMMENTS	
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AGE FORM!	CLASS	DES	CRIPTION	1	i . '. 	LOG	DEPTI m	GR	AIN S	SIZE	CL Sp Sp	.AY SS	SA %%	ะ SS รู ND	SPECIAL	COMMENTS	DEPTH FT.
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C Cc	are	se sand	0·50-1·00 1·00-2·00	cs	Clay sai	nd		45	- 55 - 70	"	amp		DF	RILLE	RAVAN RO 27.6.74	TCD. D	W.W.
	bbl	es	2·00-64·00 64·00-256·0	MS	Moderat Slightly	ely san	dy	70	-85 -95	W	et	٠٠٠	FI	NISH	27:8:74.	CKD. A	F
PE NO. S	032	3 MG	*		Clay	•		95	- 100) -			SH	EET.	/ OF. / DI	RG.NO. S.I.I.	8.7

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MINE	RAL	5AND No 910/75	, PI	.AN	REF.74-/	00651	EC /6	9	.HD	F	m	715					TH	
AGE FORM!	CLASS		CRIPTION	~ 7	i i	LOG	DEPTI m	IGR.	AIN S ≅∪§	IZE	C S & S	LAY:	SA!	통 R ND	SPEC	IAL CO	MMENTS	DEPTH FT.
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(3R/	IN SIZE	(m.m)		CLAY:	SANI	<u> </u>	1%		ay)	1846	1167	URE		NV	IDC	NMENT		DECOL	PCE.
·		ine sand	0.05-0.15		Clean s Slightly	and		•	0 -	- 5 - 15) 'Y	JAE				DIVIS	NOI	l	
		and m sand	0·15 = 0·25 0·25 = 0·50	MC	Moderat Very clo	ely clo				30 45				l			10 184 Auger		LOGGEI	
C Co	ars	e sand	0.50-1.00	cs	Clay sai	nd		4	-5 -	-55				D	RIL	LE	RA van k		DATE?	0.8.74 ww
P Pel	oble		ely sa				- 70 - 85	w	et	::				20.87. 26.87		TCD. A	I.F.			
CO Col	ololo	es	Slightly			8	35-	95							OF/D					

PF NO 510323 MG

LONG PURP MINE BORE	OSE RAI S/	- Sand No 910/75	L	OG PRO	OF JECT MON N REF74	ROTA ONARTO -DOG S	RY C.C.C. EC.C. EPT. E	0 <i>N5</i> 77 3K	DR TRO	IL ICT	L Tor	HO v si nis) L	E		R D A E	IG . C EPTH NGLE ZIMU LEV	NO MC I. Gemco 7.0 m Vertica TH -	
AGE FORMŅ	CLASS	DES	CRIPTION	1		LOG	DEPT m	Ή GI 5	RAIN L S C	SIZ	E S	CLA\	/: >8	SA SS	% SS ⊆	SPEC	AL C	OMMENTS	DEPTH FT.
Recent	-	Red brown															***************************************		
		Rad-brown ë	CALCAREOU	5 57	TAINS.	<u> </u>	1	_	. . ,	.									
•		Red-brou	on plastic	C	AY	000	2.											Bersen Anne September 1988 - Bersen	-5
		CLAY - as	s above				3-	_											,,
2/		CLAY - as	above			==				1	11								-10
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o/eistocene	Waste	CLAY - as	above				5.											<u>ـــ حن</u> ـ	-15
9/0		CLAY - OS					6										. : <u></u> ÷	· · · · · · · · · · · · · · · · · · ·	
		CLAY - as to orange	above be brown cl	ut g ayeg	ivades y finesan		. 7								, defined a		·		-20
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		Hole st	opped b	eca 7.	ruse of			-	-	+		- -		-	-	·	<u> </u>		
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	GR.	AIN SIZE	(mm)	CLAY :	SAND	1 7	<u></u>	lay) [N	1019	STURE	Ц :Т	EN	VIR	J NMEN	Т 8	RESOUR	CE	
				-	Clean s	sand		0	- 5				1				เรเดิเ		
F Fir	10	fine sand sand	0.05 - 0.15 0.15 - 0.25	MC	Slightly Modera	tely cla		15	- 15 - 30))ry					10.18		LOGGED	1/1/
		m sand e sand	0·25 - 0·50 0·50 - 1·00	VC CS	Very cl Clay so				- 45 - 55	11 6)ar	p		DR	PE.	AUGE. RAVan	Rens	A.M. P.	
VC Ve	ry (oarse sand	1.00-2.00	٧s	Very so	andy		55	-70) <u>.</u>	No+	•••		ST	ART	20.0	74	TCD DA	V.W.
P Pe CO Co	ldd Idd		2·00-64·00 64·00-256·0	Modera Slightly		dy		-85 -95	' I		<u></u>	L		····	28.8		CKD. A.		
P.F. NO. SI	032	3 VG			Clay	·		95	- 10	0			1	SHE	ET.	/.OF./.	DRG.	NO. S	93

HOLE NO MC 13 DEPARTMENT OF MINES-SOUTH AUSTRALIA RIG Gemco LOG OF ROTARY DRILL HOLE DEPTH . 6.0m LONG PROJECT MONARTO CONSTRUCTION SAND ANGLE Vertical. PURPOSE ... PURPOSE - MINERAL Sand PLAN REF74-1006 SEC //7 HD Finnis ELEV D.M. 770/74 ... REPT. BK. ... BORE S/No 9/0/75 SPECIAL COMMENTS DEPTH AGE SA S DESCRIPTION FT. 0_0 0_0 Red-brown aeolean SAND Recent Pinkish-brown calcareous SOIL 00 Red-brown plastic CLAY 5 2oleistocene CLAY - as above 3-CLAY - 05 above CLAY - as above 15 5-CLAY - as above 60m End of hole Flight of auger jamming in ENVIRONMENT & RESOURCE (%Clay) CLAY : SAND MOISTURE GRAIN SIZE (mm) 0 - 5DIVISION SA Clean sand 5 - 15 Dry VF Very fine sand SC Slightly clayey 0.05-0.15 DRILL NO. 184 LOGGED 15 - 30 MC Moderately clayey F Fine sand 0.15 - 0.25 A.M. PAIN TYPE Auger 30 - 45 0.25-0.50 VC Very clayey Damp M Medium sand DATE 28 8 74 DRILLERA Van Rens 0.50~ 1.00 CS Clay sand 45 - 55 Coarse sand START 20.8.74 TCD DWW. 55-70 VC Very coarse sand 100-200 VS Very sandy Wet 🔃 FINISH . 28:8:74 CKD. A.F. 70-85 2.00-64.00 MS Moderately sandy P Pebbles 85-95 64 00-256 0 SS Slightly sandy CO Cobbles SHEET / OF / DRG.NO. S 1194 95 - 100 CL Clay

P.F. NO. S10323 MG

1 47			DEPART			INES.					_			HOLE N	10 MC 14 emco	-
LAT			LOG		ROTA	. , ,				HOI				DEPTH	12.0m	,
PURPO				ECT MO											Vertica	%.
MINER	JAS Ne	5and 10 910/75		REF.74		EC ??? EPT. BY		10.		,,,,,				AZIMU [*] ELEV.		
AGE			-, -, -, -, -, -					N SI	7F (CLAY	S	AN	σТ	 		DEPTH
FORM	CLASS	DESCRIPT			LOG	DEPTH m	≯ ⊤ ₹	ري	_ 8 శ	တွင် လူသည်	ပ္သ	s S	ន្តជ	SPECIAL CO	MMENIS	FT.
Recent	9/8	Soft white CALCI			00	_										
-		Orange SAND & C	RAVEL			/	1			-			4		· • • •	
		Oronge SAND & C	GRAVEL											F.M. = 3.52		-5
					-	2—			\mathbf{I}_{\pm}			- -	+ +		<i></i>	
		Orange SAND & C	GRAVEL													
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		Orange same	UKNVEL											11.01% c/c	ry	
	2	Orange SAND &	GRAVE	<u> </u>	Ţ <u>.</u>	4			******		7 -		\prod		en Enné verprésad de la company	ا ہر ا
	SANL					5-								, annua summan status sentrific		-15
	2	Orange SAND &	GRAVEL											F.M. = 3.62		
	10/	<u> </u>			L: -:	6-			\mathbb{I}_{+}		-	-	-	8.88% cla	<u>y</u>	_20
2	,CC	Orange SAND &	GRAVEL	<u> </u>		-	1									
Tertiary	57.R					7	1				- -	+ -	+1+	F.M. = 3.10		1
7	ON	Yellow-orange fil to orange SAND 8			9. : ::	-	1							7.35% CI	'ay	-25
10	2					θ-	1				1		1			
	RSE	Orange SAND &	GRAVE	Z		_ _ _										<u> </u>
	140	Orange SAND &		- 							T	\prod			, , , , , , , , , , , , , , , , , , , ,	-30
	0	= = ·		-		10					-	$\downarrow \mid$	$\perp \parallel$.]
		Orange SAND												F.M. = 2.59	i VI .	-35
	<u> </u>	,				//	1			- -	+	1+	.]-	22.73% c/a	Bimodal	
	63	Grey plastic mid (Weatherea			+ + +		$\left\{ \mid \mid \right\}$									
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<u> </u>	GP	 AIN SIZE (mm	<u> </u>	CLAY :	SANIT) (%Clc	1/7	MOIS	STURE	1	= NIV	VIRC	NMENT &	RESOUR	L RCF
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		fine sand 0.05-0 sand 0.15-0		Slightly Modera			15 - 15 -		Dry					10 184	LOGGED	
м м	ediu	m sand 0.25-0	-50 VC	Very cl	ayey	-y ~y	30-	45	Dan	ip 🛛	'	ΤY	PE .	Auger	A.M. PA	
		se sand 0.50-1 coarse sand 1.00-2		Clay so Very so			45 - 55 -				ľ			RA van Rens 3.9.74	DATE 3:	W.W.
P Pe	bbl	es 2.00-6	400 MS	Modero	itely sai		70-	85	Wet	\Box				3.9.74	CKD. A	F
CO Co	dda	es 64·00-25	sandy		85- 95-				5	HE	ET.	/ OF. / DRG.	NO. SIII	95		
CL Clay 95-100 SI															- 	

DEPARTMENT OF MINES-SOUTH AUSTRALIA HOLE NO MC 15. LOG OF ROTARY DRILL HOLE RIG Gemco LONG DEPTH . II.Om PURPOSE - MINERAL Sand PROJECT MONARTO CONSTRUCTION SAND ANGLE Vertical PLAN REF74-1007 SEC 107 HD Finnis AZIMUTH...... D.M. 770/74 REPT. BK. BORE S/No 9/0/75 ... ELEV LOG DEPTH GRAIN SIZE CLAY: SAND AGE SY J SPECIAL COMMENTS DEPTH DESCRIPTION Pleistocene % Red-brown SOIL & nodulor CALCRETE 0 0 Coarse quartz GRAVEL F.M. = 3.89 Coarse quartz GRAVEL .5 20.86% Clay 2-Coarse quartz GRAVEL 3--10 F.M. = 2.68 Orange SANO 11.25% Clou SAND ____ Orange SAND & GRAVEL 15 5. F.M. = 3.51 Orange SAND & GRAVEL 9.67% Clay Bimodal · --- --- ---.20 Orange SAND & GRAVEL F.M. = 3.02 Orange SAND & GRAVEL 9.67% Clay Bimodal 25 8-Orange SAND & GRAVEL 9_ 30 F.M = 2.63 Orange SAND & GRAVEL 12.937, Chy Bimodal 10 Orange SANO & GRAVEL 35 White CLAY (weathered GNEISS) Basement 11.0m End of hole GRAIN SIZE CLAY : SAND (%Clay) (mm) MOISTURE ENVIRONMENT & RESOURCE 0 - 5 SA Clean sand DIVISION VF Very fine sand 0.05 - 0.15 SC Slightly clayey 5 - 15 Dry -DRILL NO. 184 ... LOGGED 15 - 30 F Fine sand 0.15-0.25 MC Moderately clayey A.M. PAIN TYPE Auger ... VC Very clayey M Medium sand 0.25-0.50 30-45 Damp DRILLERA.Van Rens DATE 3.9.74 C Coarse sand 0.50-1.00 CS Clay sand 45 - 55 START 3.9.74 TCD DWW. VC Very coarse sand 1.00-2.00 VS Very sandy 55-70 Wet 🖸 P Pebbles 2.00-64.00 MS Moderately sandy 70-85 FINISH 3.9.74... CKD. A.F. 64-00-256-0 SS Slightly sandy CO Cobbles 85-95 SHEET / OF / DRG.NO. S 11196 CL Clay 95 - 100 P.F. NO. S10323 MG

			DEP	ART	MENT	OF N									HOL	E NO	MC 1	ž
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		Sand			REF.74												нт.	
		10 9/0/75			770/74													
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Cene		Red-brown 6				==	1 .											
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	:110	Orange SAI	ND 6 GRAVE.	Z			-	1							17.48	% Cla	ry	-5
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3)	25	orange SA	NO & GRAVA	=/			j -	11		i			11					1
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Ö.	ž	Oronge SA	NO 6 GRAV	EL			,	$\frac{1}{2}$							9.96%	, Clay	/	
K	Coarse		ND & GRAV				4-	1+	-		11	1	+	+		- .—		-
Poloeo-	-	Off-white			FICE	1 4	+	1										-15
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Base- ment	<u> </u>	Off-white o	ZAY (Wthro	GI	VEISS)	++		+1										
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<u> </u>	GR	AIN SIZE	(m m)		CLAY:	SANI	- 7	%C	lay)	M	OIST	URE	EN	VIR	ONMEN	Γ£	RESOL	IRCE
SA Clean sand 0-5 DIVISION																		
		fine sand			Slightly				- 15		ŗy		DR	ill	NO 184]	LOGGE	D
		sand um sand			Modera Very cl		ayey		- 30 - 45	1		771	T	/PE	Auger	·	A.M. F.	AIN
		um sana se sand			Clay so		-		-55	D	amp		DF	RILL	ERA. Van	Rens	DATE	3.9.74
VC V	ry	coarse sand	1 00 - 200	٧S	Very so	andy		55	- 70	١,,	le†	•••			3.9.7		TCD.	W.W.
	P Pebbles 2:00-64:00 MS Moderately sandy 70-85 CO Copples 64:00-256:0 SS Slightly sandy 85-95																	
1 00 0	210 K	ies	94.00_529.0			sundy	y			- 1			sн	EET.	/.OF./	DRG.	10.511	197
PE NO S	CO Cobbles 64-00-256-0 SS Slightly sandy 85-95 SHEET / OF ./ DRG.NO. S 111.97																	

LONG PURPO MINEI	DSE RAL	sand	PARTMENT OG OF PROJECT MOPLAN REF	ROTA WARTO 1007 S	RY COMEC 16	D ISTA	RII PUC. HD	L TIOI FII	HO v <i>sa</i> nnis	LE NO	·	RIG . DEPTI ANGL	NO MC 17 Gemco 1 150 m E Vertico	/
	· .		D.M. 770/74	,	DEPTH						ND		OMENTO	DEPTH
FORM	ਹ	DESCRIPTION		200	m	<u>></u> ⊩ ≥	د د <u>د</u>	۵.8	g & S ≥ S	SSS	្តិនដ	SPECIAL (OMMENIS	FT.
Pleisto- cene	9/0	Red-brown SOIL & nod		·	-		1							
)	Quartz GRAVEL in li Red-brown SAND & C		0.0.	/-					-	- +			-
		Red-brown GRAVE	<u> </u>		2_								<u> </u>	
	:	Red-brown SAND & C	GRAVEL		3- - 1									
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27.4	stion		<u> </u>		9-	- - -	į		-	+	- + -			
Tertiary	struc	Orange SAND			10	-		-			+			
	CON	Orange SAND 			//-				-	+ +	- -	alama, aranti sujen aranjin		
	Coarse	Orange SAND & GRA			12	-			-		+		<u> </u>	
	22	Orange SAND & GRA	<u> </u>		/3-									.:
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Palpeozok Basement		Orange SAND & GRA Grey CLAY (wthrid		++++	15	1 7								
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	3R/	AIN SIZE (mm)	CLAY:		(9	6Clo		MOIS	STURE	EN'	VIRC	NMENT &	RESOUR	CE
1	-	fine sand 0.05-0.15 sand 0.15-0.25	SA Clean s SC Slightly MC Moderat	clayey		0 - 5 - 15 -	15	Dry		DRI	LL N	DIVISIO 0. 194	LOGGED	
M Me	diu	m sand 0.25-0.50	VC Very clo	yey		30-	45	Dan	np			Auger RAvan Rens	DATE 3:5	
VC Ve	ry c	e sand 0.50-1.00 oarse sand 1.00-2.00	CS Clay sai	ndy		45 - 55 -	70		∷	ST.	ART	3.9.74	TCD. DW	.W.
P Pel	oldd oldd		MS Moderat SS Slightly CL Clay			70-1 85-1 95-	95	vvei	•••			3.9.74 OF / DRG	. CKD. A.	
PE NO SI	232	3 MG	J.Gy				.55							

LAT			PARTMENT	of N	INES		отн RIL		STRA			HOLE NO		3
		-	, o o.								1	DEPTH.		7 .
			ROJECT MC	1007 c	c 10	7	KUC	FIN	יני זייו ממו	7712		ANGLE .		′
			M 770/74				. עח	4 557	STATE.	• •		ELEV.		• • •
	<u> </u>	<u> </u>		Т	DEPTH		N SI	7F [C	ΊΔV:	SAN	рΤ		_, :	DEPTH
AGE	CLASS	DESCRIPTION		100	m	7 - 2	υ S	_ S\&	S ₹ 5 €	S & ₹	នូក	SPECIAL CO	MMENTS	FT.
Quateri	- 5	Red-brown SOIL & nodule	or CALCRETE	0-0-		ПТ								
ary	200	Quartz GRAVEL in lir	ny 5011	0.0:										
	7	Pale brown SAND & G	RAVEL		\							F.M. = 3.73		-5
	\omega_u		·		2-						<u> </u>	12.52% Clay	<u></u>	
	1,0	Pale brown SAND & G	RAVEL		\		3							
	BU		·		3								<u> </u>	_0
	3	Orange-brown SAND	& GRAVEL		-							FM. = 3.33		
	180				4-					41		11.82% Clay	/ 	
	8	Pale orange SAND												-15
			<u> </u>	==	5_	44				4 +				
	ste	Pale yellow-orange	SAND	=-	· .							F.M. = 1.28		
	Woste	-		===	6-					$H \vdash$	+ -	4.78% Clay	′	_20
	_	Pale yellow-orange	SAND		.] -						1			
6.	7	and the contract which were	e memos opinion -		7-	-		+	\blacksquare	-	+ $+$	F.M. = 2:22	 -	
Ô	0,2	Pale yellow-orange	SAND			+						5.63% Clay	,	-25
r 7.	2		<u> </u>		8-		-				+			-
Tertiary	10,	Pale yellow-orange	SAND		•	- 1								
	12		<u> </u>		<i>9</i> _	-	h	┪ ├		H+	$\ + \ $		 -	-30
	181	Orange SAND & GRA	VEL			-						F.M. = 3.03 7.97%Cloy	Dimendal	
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SHEET / OF/ DRG.NO. S 1.1202 .

PE NO. S10323 MG

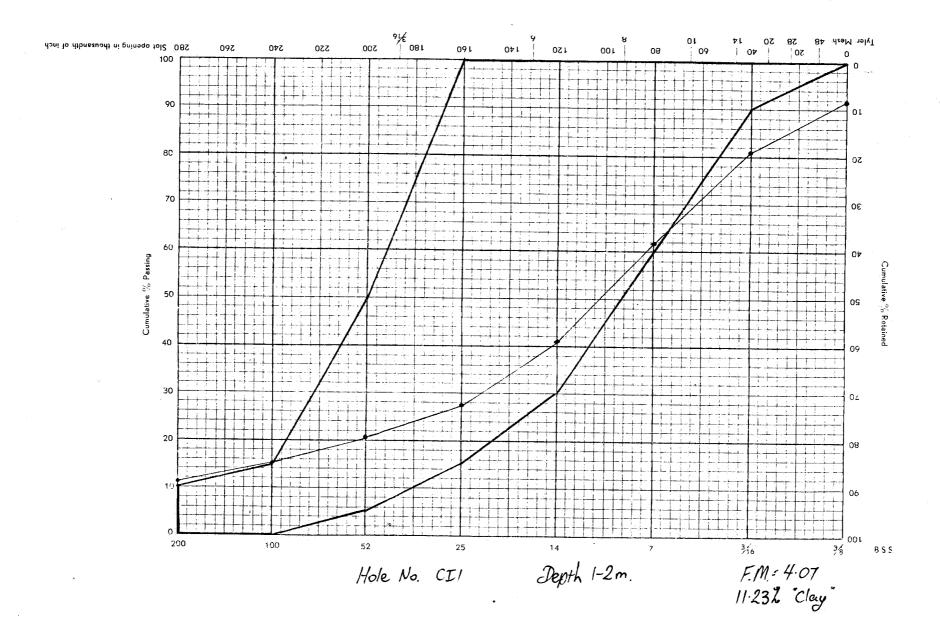
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GRAIN SIZE (mm) CLAY: SAND (%Clay) MOISTURE ENVIRONMENT & RESOURCE														RCE							
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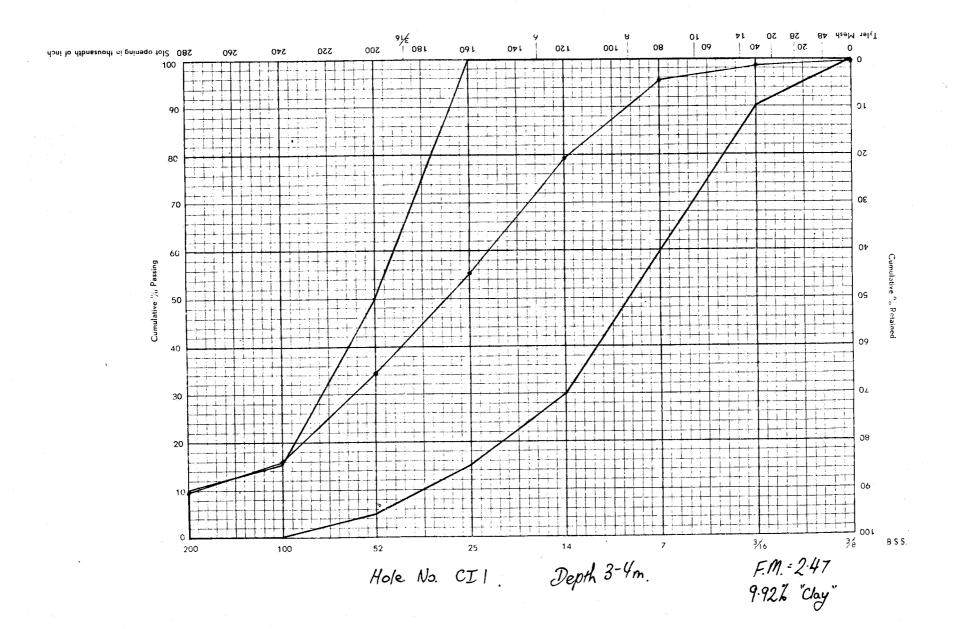
HOLE NOMC 23 DEPARTMENT OF MINES-SOUTH AUSTRALIA LOG OF ROTARY DRILL HOLE RIG Gemco LAT LONG DEPTH 5.5m PROJECT MONARTO CONSTRUCTION SAND ANGLE Vertical PURPOSE ... T... MINERAL Sand PLAN REF.74-1007 SEC 107 HD Finnis AZIMUTH. . T. . D.M. 770/74 REPT. BK. BORE S/No 910/75 ... LOG DEPTH GRAIN SIZE CLAY: SAND AGE SY FORM! SPECIAL COMMENTS DEPTH DESCRIPTION Recent \$ Soft red-brown SOIL off-whitespink nodular CALCRETE Peistocene 000 Red-brown to pinkish-brown 000 5 Gravelly calcareous SOIL Orange SAND & GRAVEL 3 IÒ Orange GRAVEL & SAND Oronge GRAVEL 15 Orange GRAVEL 5.5m End of hole Hole stopped by GRAVEL %Clay) GRAIN SIZE CLAY : SAND MOISTURE ENVIRONMENT & RESOURCE (mm) SA Clean sand 0-5 DIVISION 5 - 15 Dry VF Very fine sand 0.05-0.15 SC Slightly clayey DRILL NO. 184 LOGGED F Fine sand 0.15-0.25 MC Moderately clayey 15 - 30A.M.PAIN TYPE Auger 30-45 M Medium sand 0.25-0.50 VC Very clayey Damp DRILLERA Van Rens DATE 4:9.74 C Coarse sand 0.50- 1.00 CS Clay sand 45-55 START . 4.9.74 VS Very sandy TCD DWW. 55-70 VC Very coarse sand 1.00-2.00 Wet 🗓 2.00-64.00 70-85 FINISH 4.9.74 P Pebbles MS Moderately sandy CKD. A.F. CO Cobbles 64-00-256-0 SS Slightly sandy 85-95 SHEET. / OF / DRG. No. S 1 204 CL Clay 95 - 100 P.F. NO S10323 MG

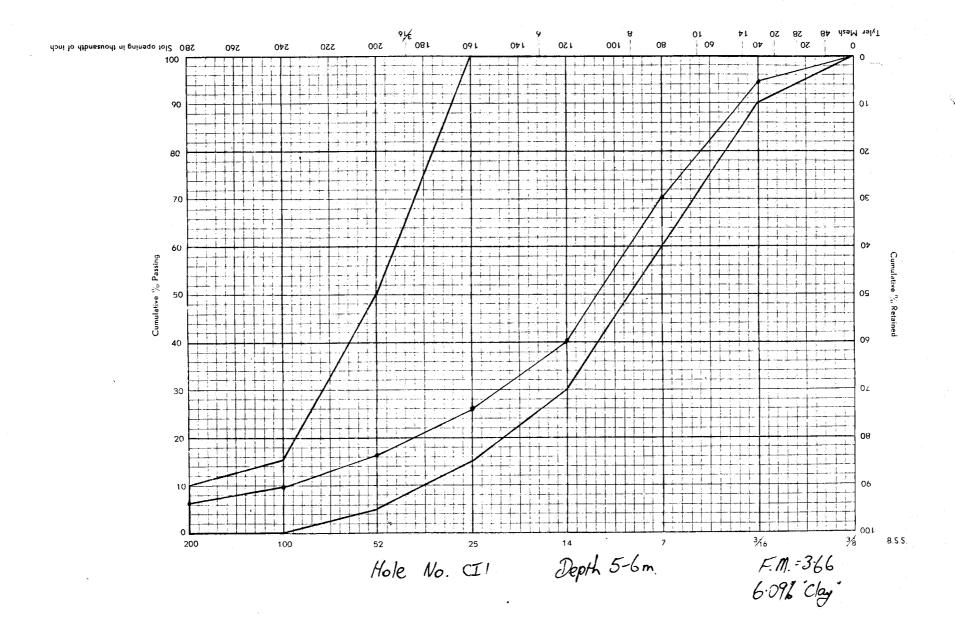
HOLE NO MC 42 OF MINES-SOUTH AUSTRALIA DEPARTMENT RIG Gemco LOG OF ROTARY DRILL HOLE DEPTH 4.0m LONGT.... PROJECT MONARTO CONSTRUCTION SAND ANGLE Vertical PURPOSE MINERAL Sond -PLAN REF 74-1006 SEC 341 HD Tungkillo AZIMUTH, D.M. 770/74 ELEV..... BORE S/No 910/75 REPT. BK. SPECIAL COMMENTS DEPTH DEPTH GRAIN SIZE CLAY: SAND AGE DESCRIPTION LOG FORM THE SON ON SENSON SENSON soft red-brown ocolean SAND • Recent 0=0 off-white pink calcreted 5012 Off-white & pink cokreted SOIL Pleisto cene 5 Grey-buff CLAY (withrid GNEISS) ++ obeozoic Grey-buff CLAY (wthrid GNEISS) 3 -10 Pole grey-brown CLAY(wthid GNESS) 4.0m End of hole GRAIN SIZE CLAY : SAND (%Clay) MOISTURE ENVIRONMENT & RESOURCE (mm) SA Clean sand 0 - 5 DIVISION Dry 🔝 VF Very fine sand 0.05 - 0.15 SC Slightly clayey 5 - 15DRILL NO 184 LOGGED Fine sand 0.15 - 0.25 Moderately clayey 15 - 30M.C. TYPE Auger A.M. PAIN Medium sand 0.25 - Q.50 VC Very clayey 30 - 45Damp DRILLERA Van Rens DATE 27.9.74 0.50- 1.00 45 - 55 Coarse sand C:S Clay sand TCD DWW. VC Very coarse sand 1:00-2:00 START 27.9.74 Vs Very sanay 55 - 70 Wet 🔛 2-00-64-00 CKD. A.F. P Pebbles MS Moderately sandy 70-85 FINISH 27. 9.74 CO Copples 64 00-256-0 SS Slightly sandy 95 - 95SHEET / OF / DRG NO. S11223 95 - 100 Clay P.F. NO 510323 MG

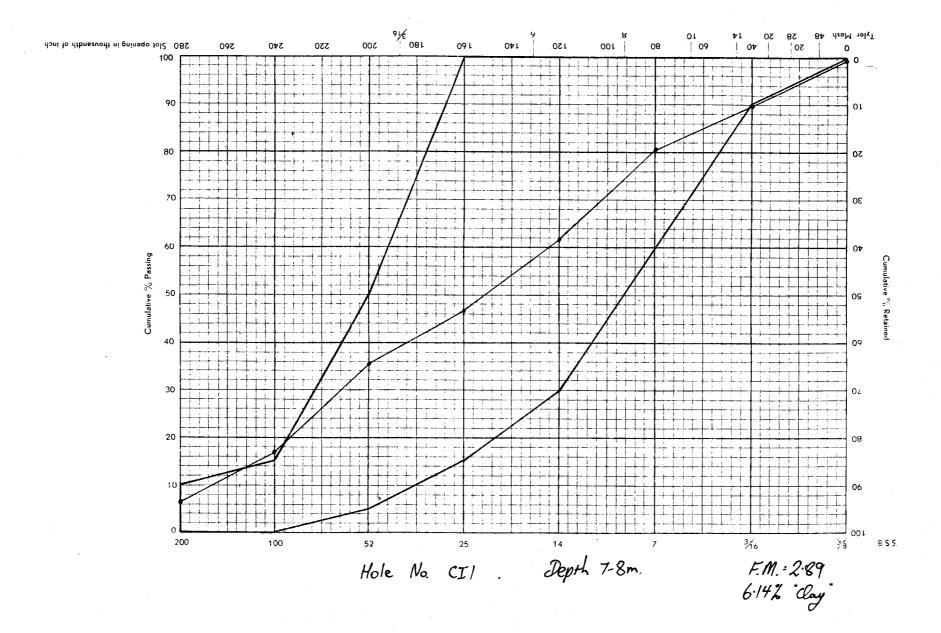
APPENDIX II

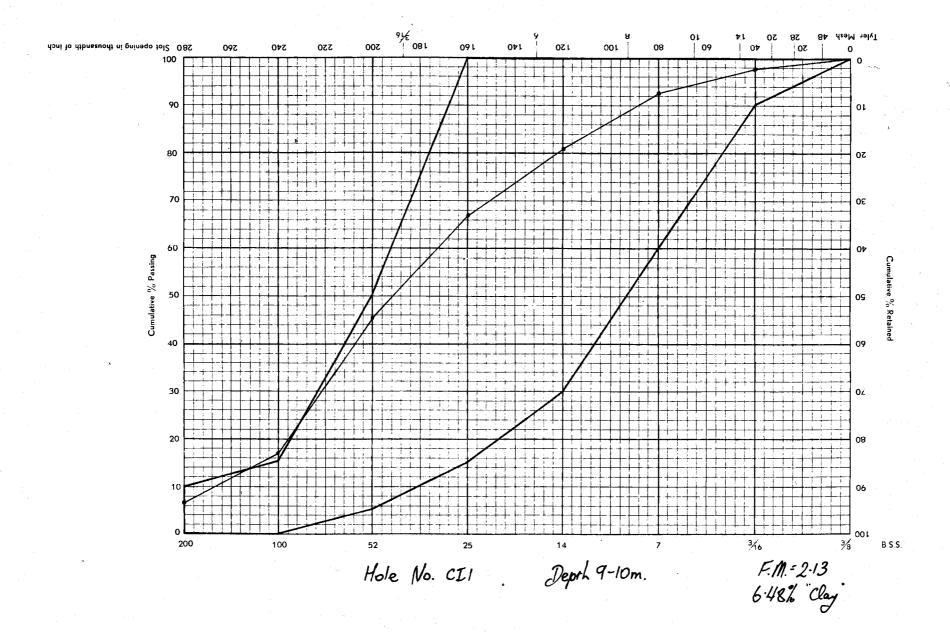
Results of Sieve Sizing Analysis

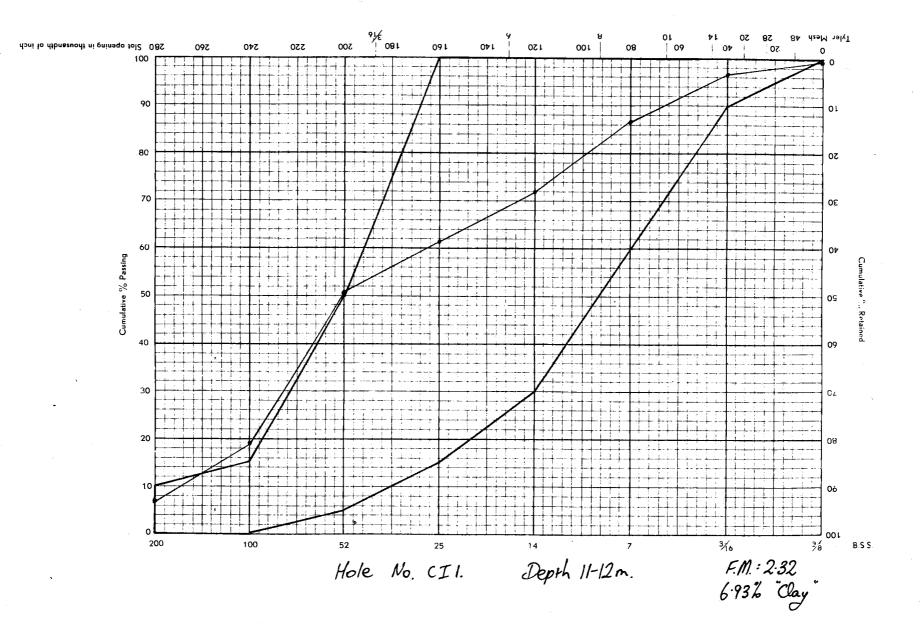


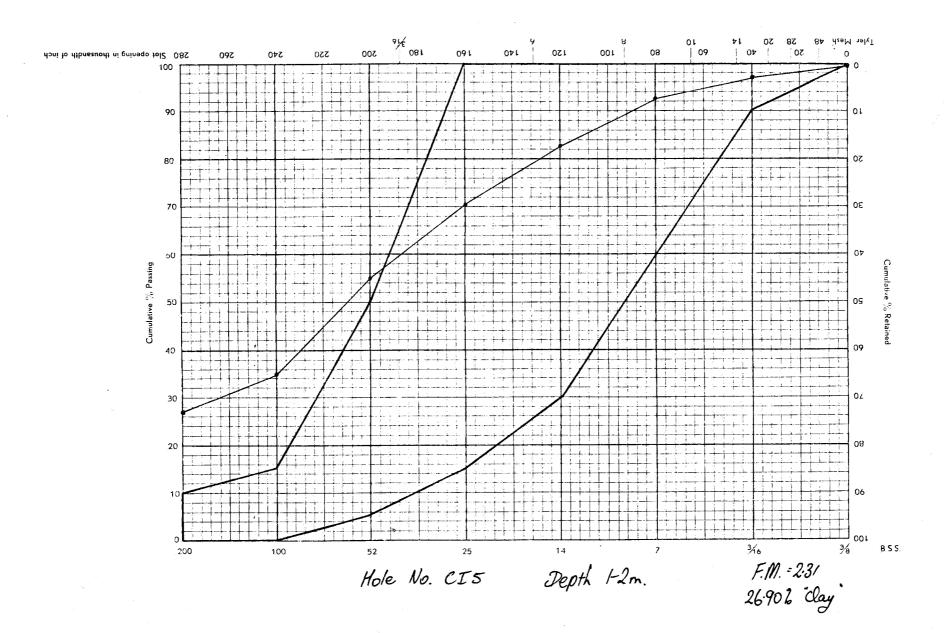


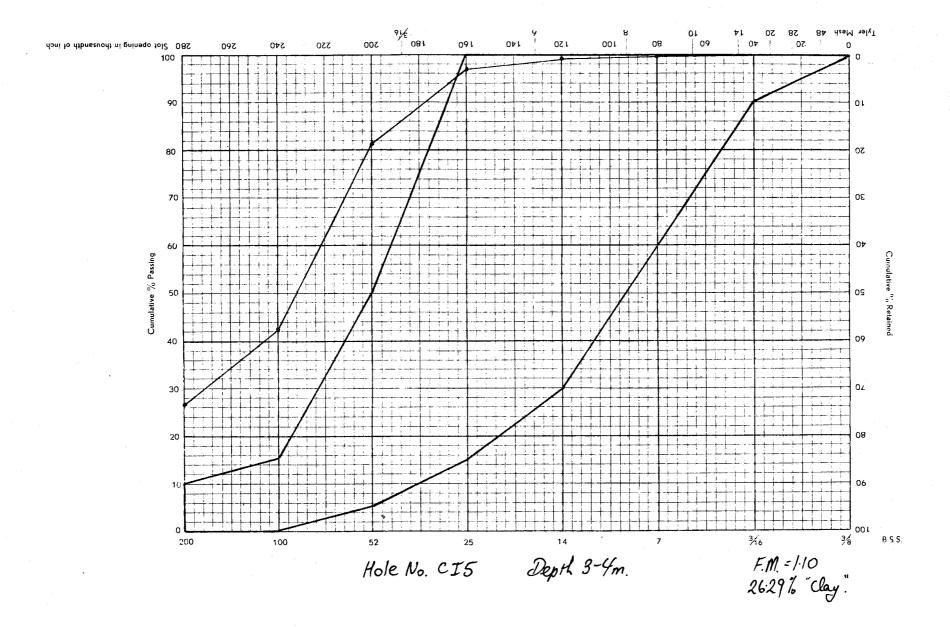


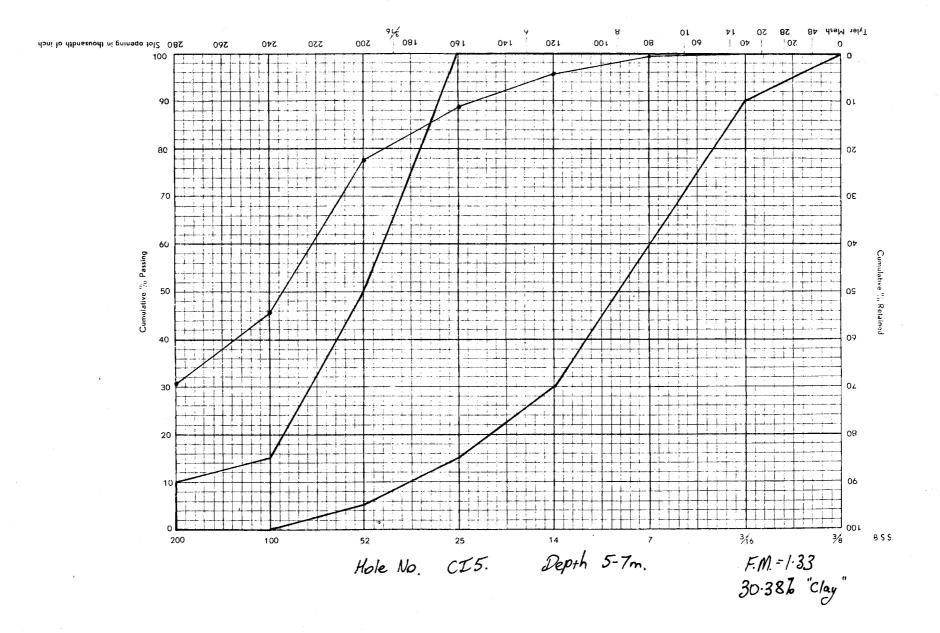


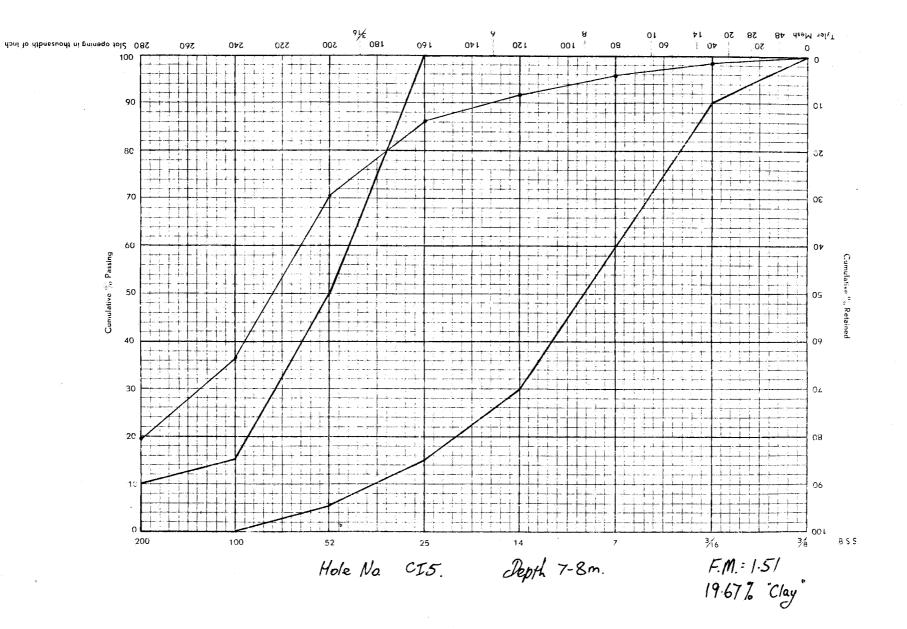


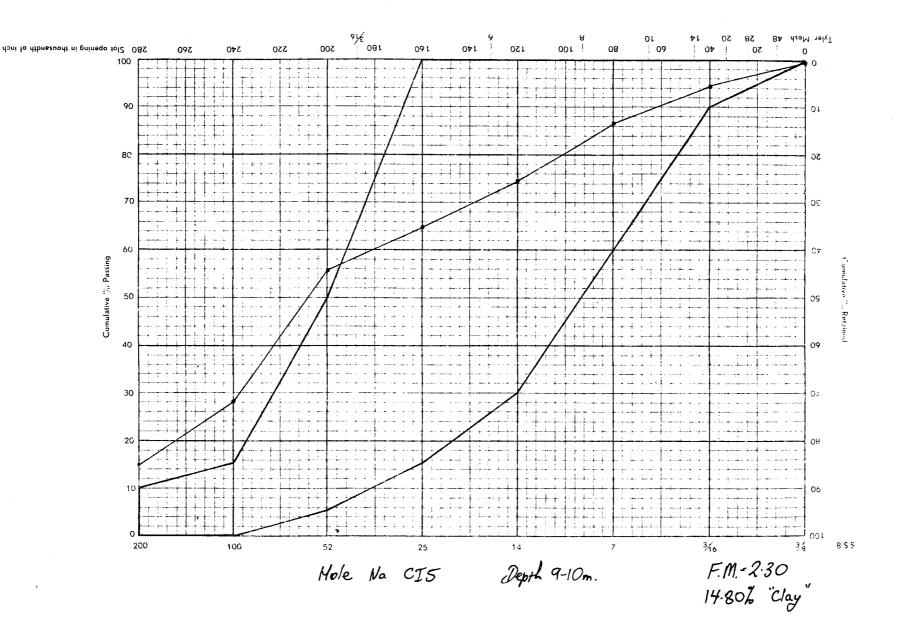


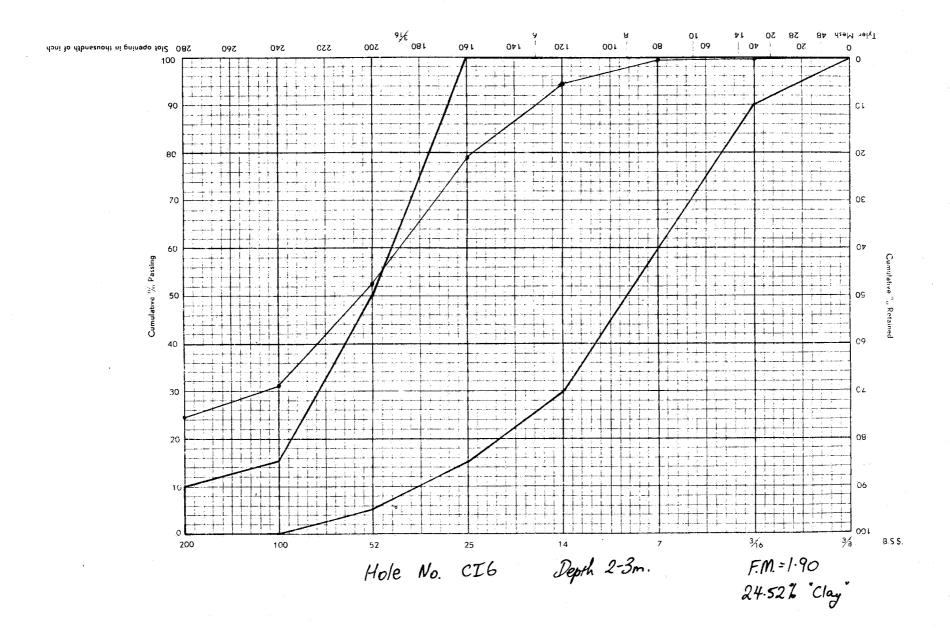


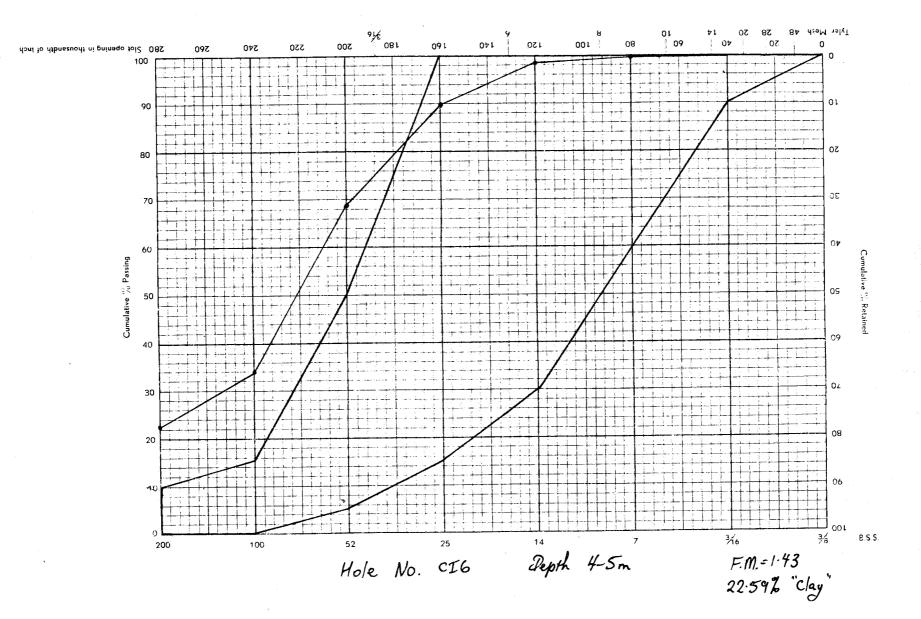


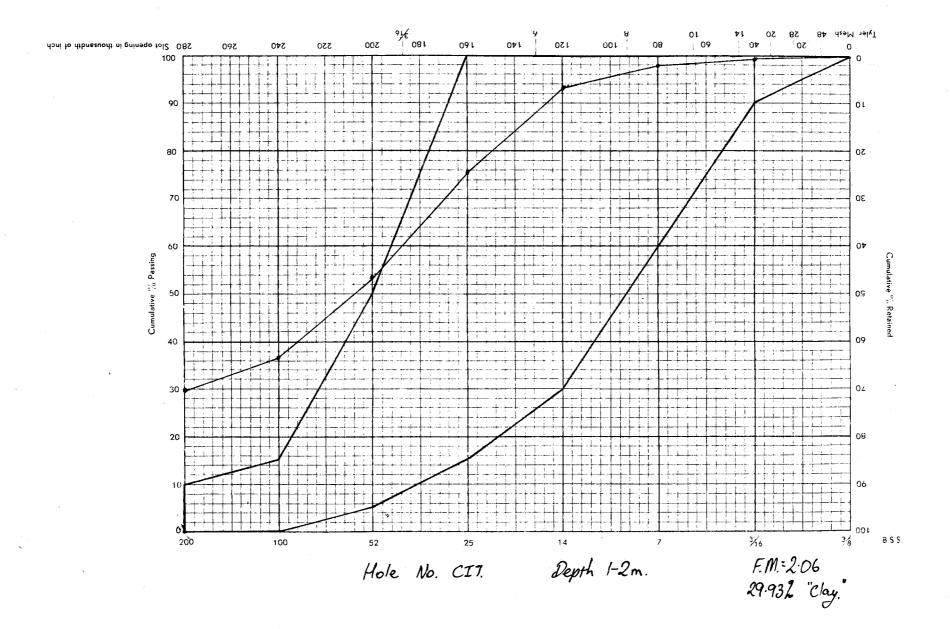


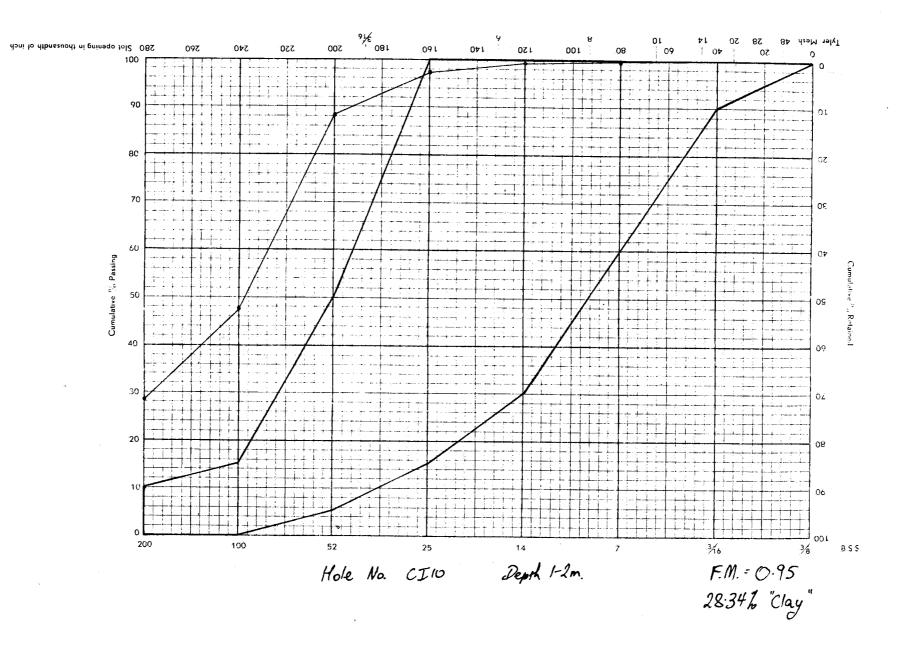


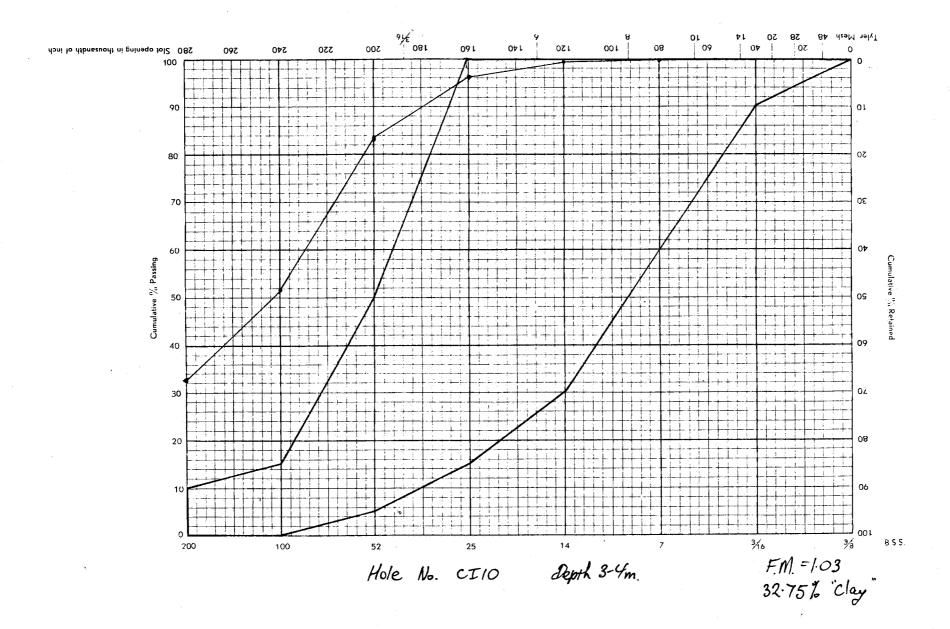


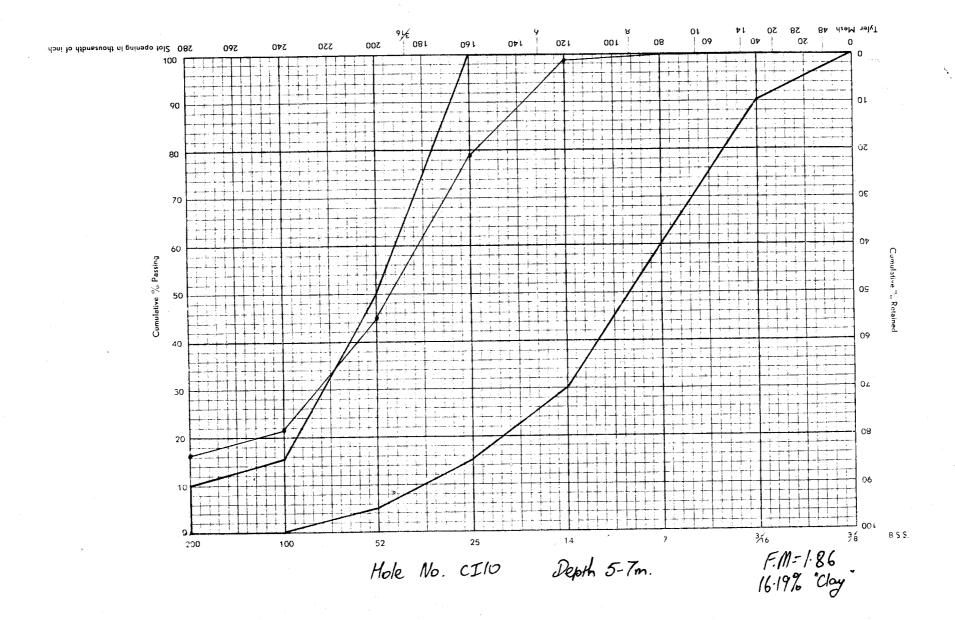


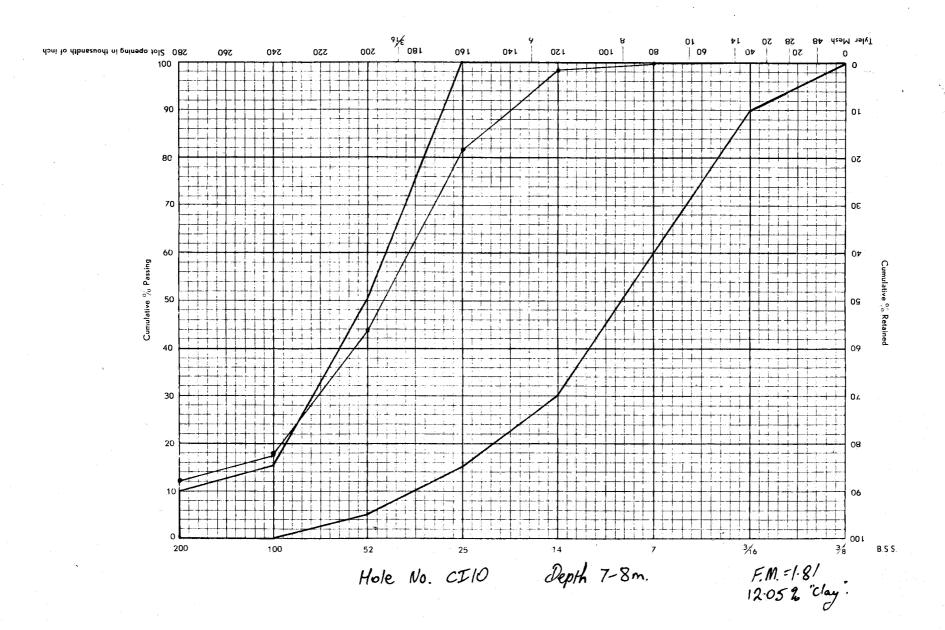


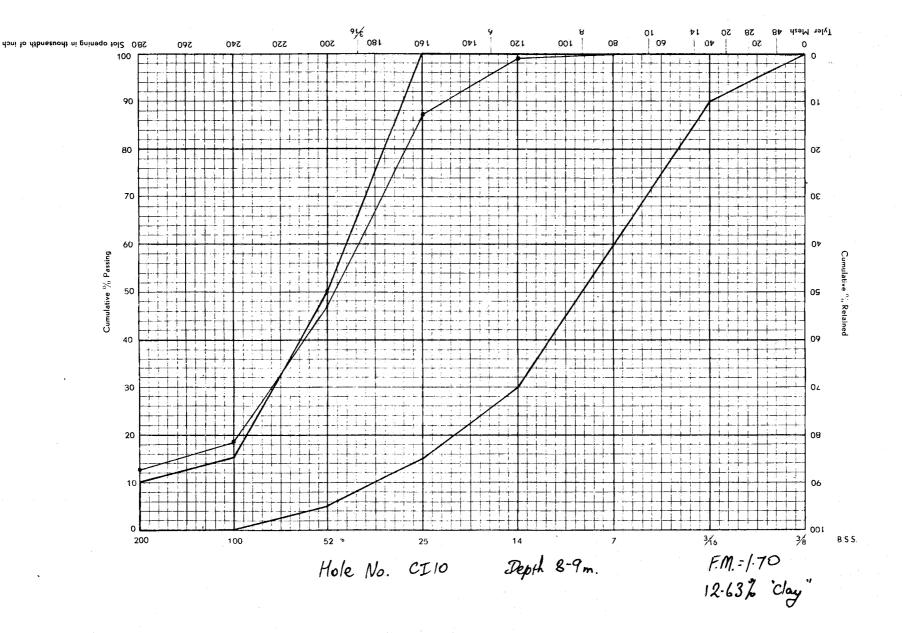


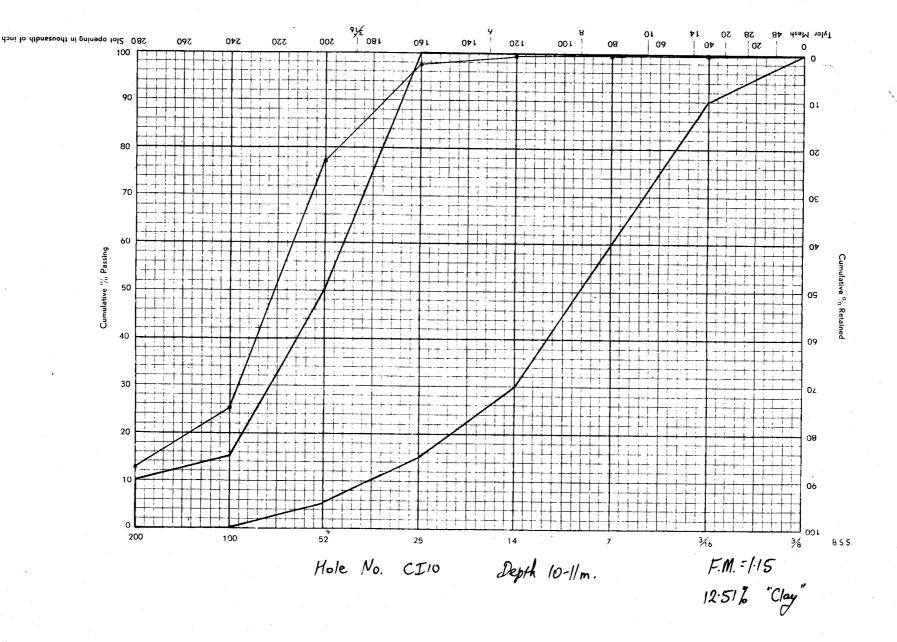


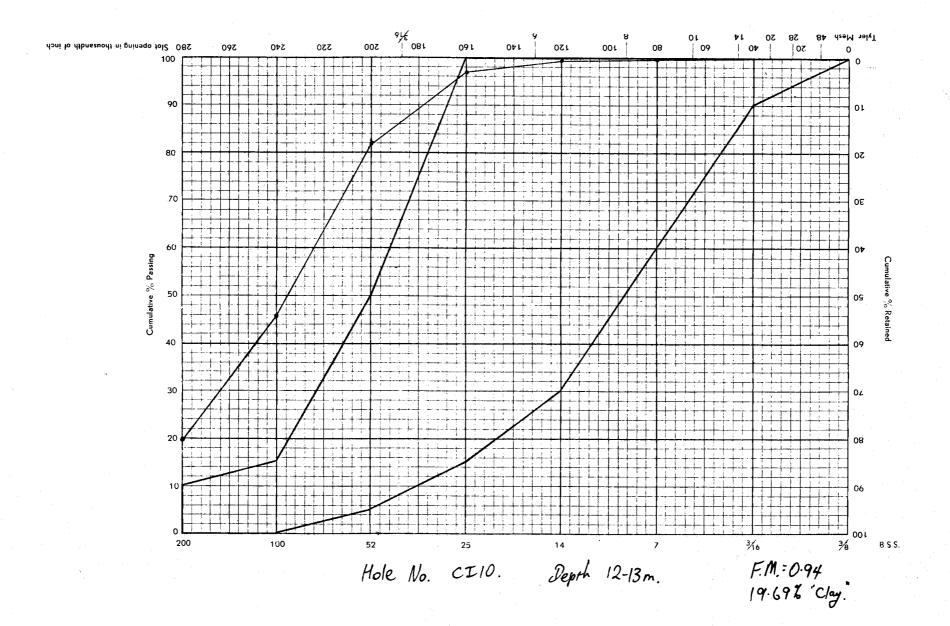


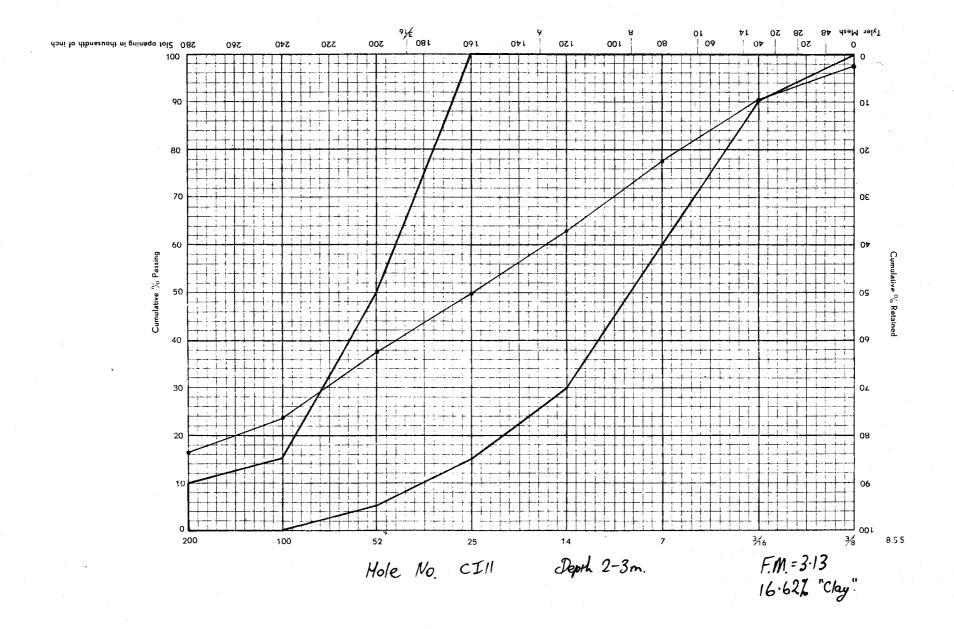


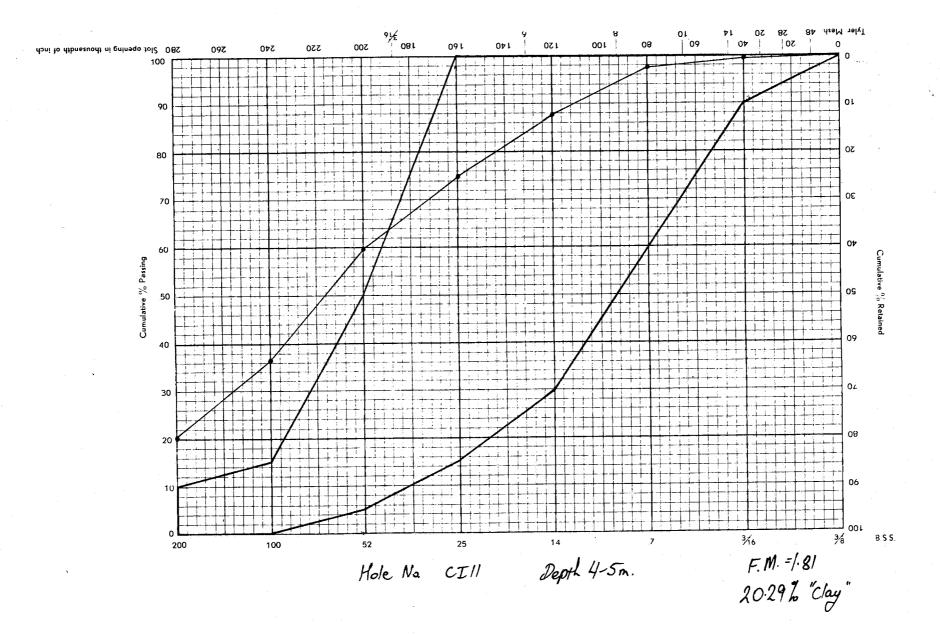


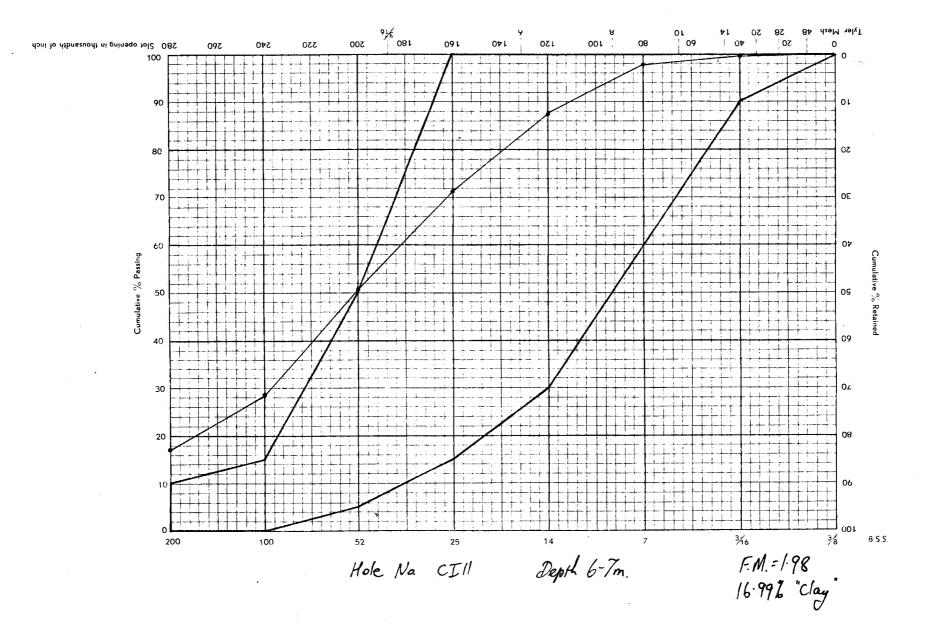


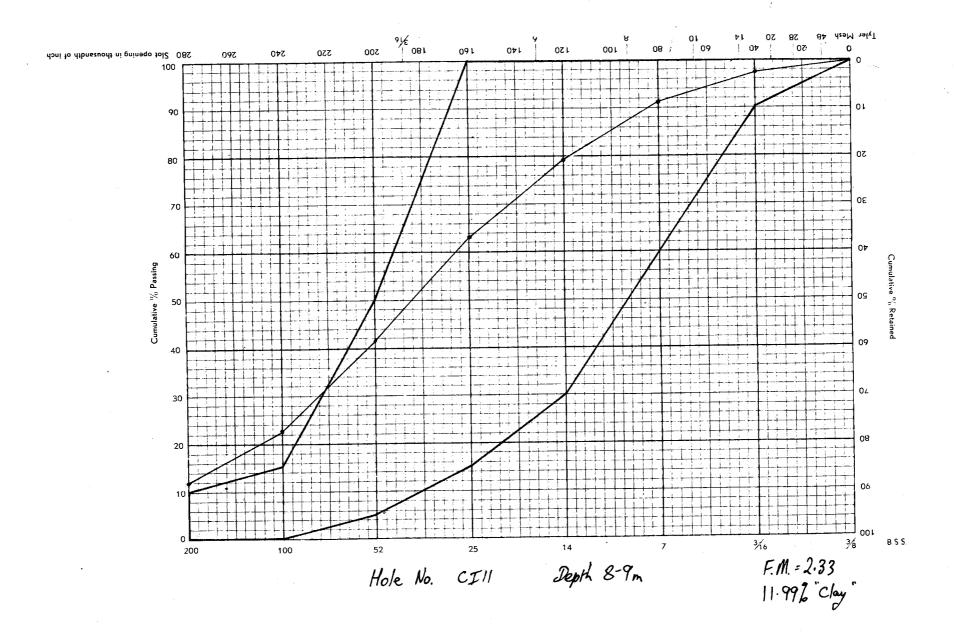


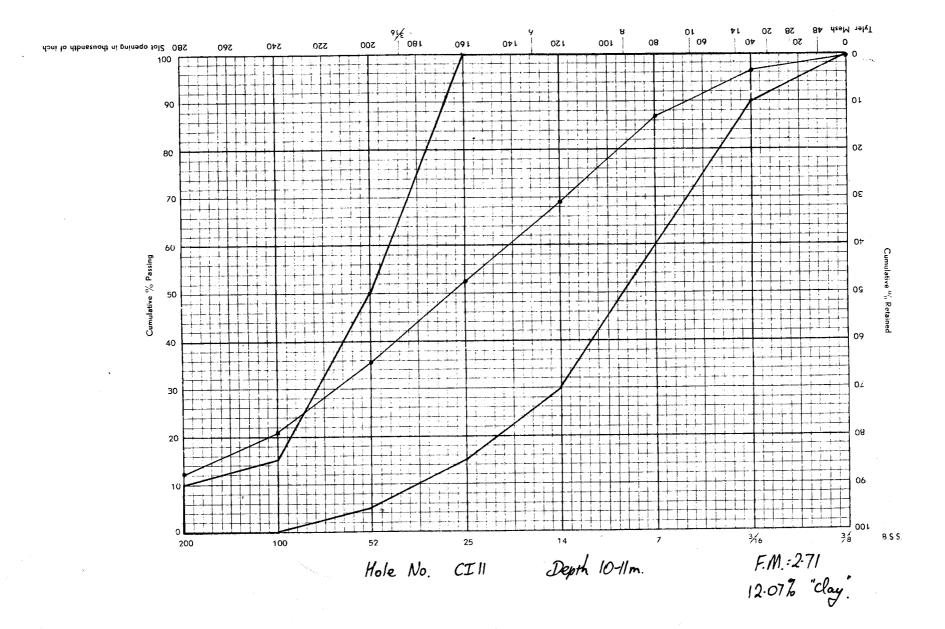


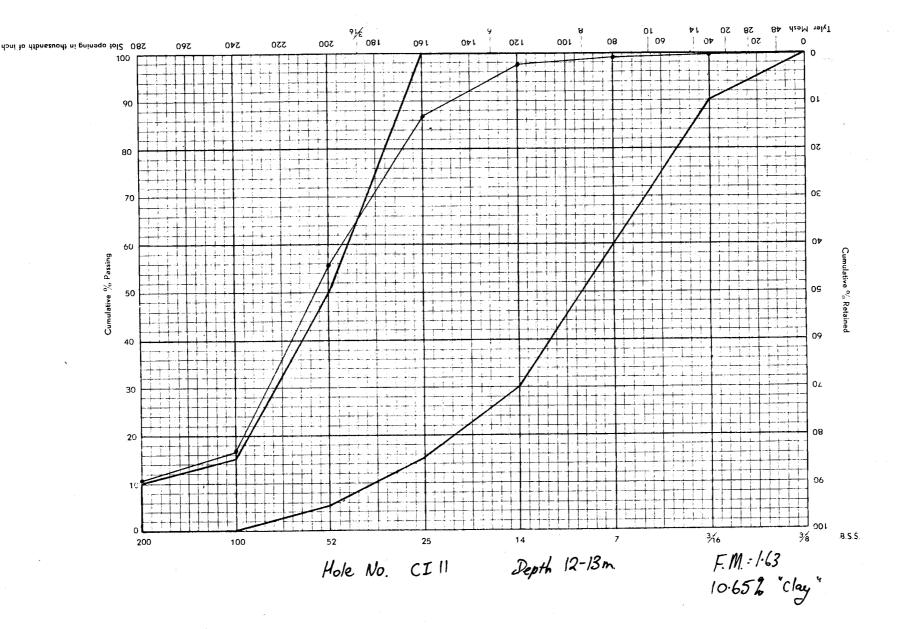


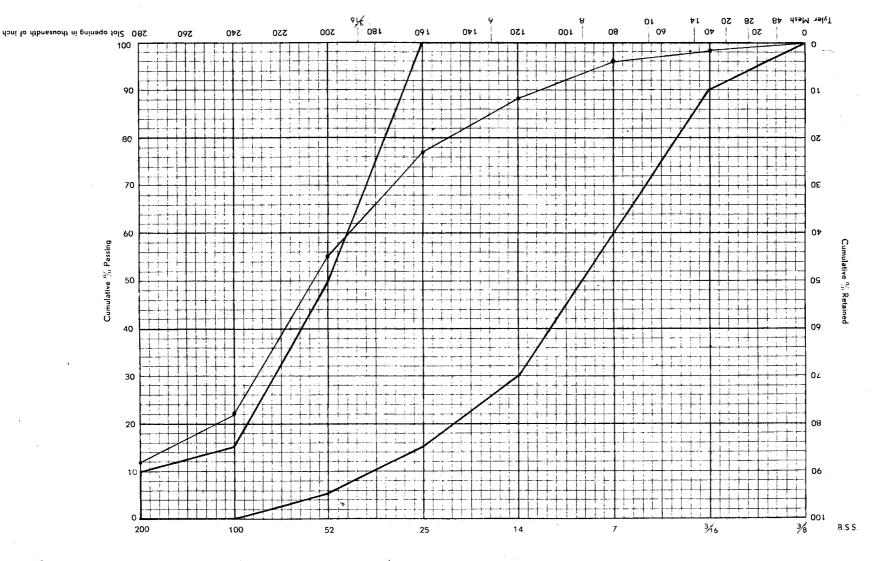








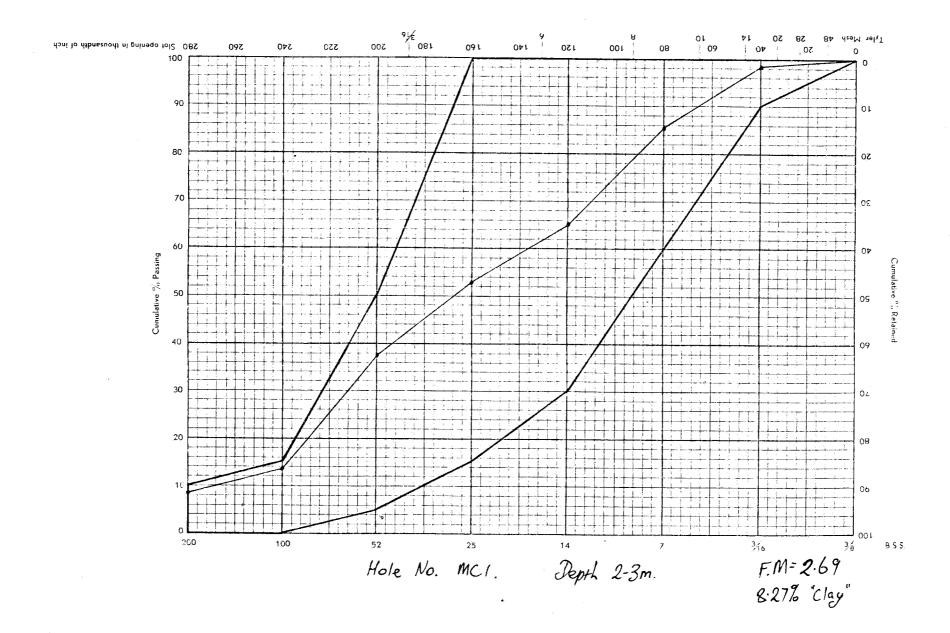


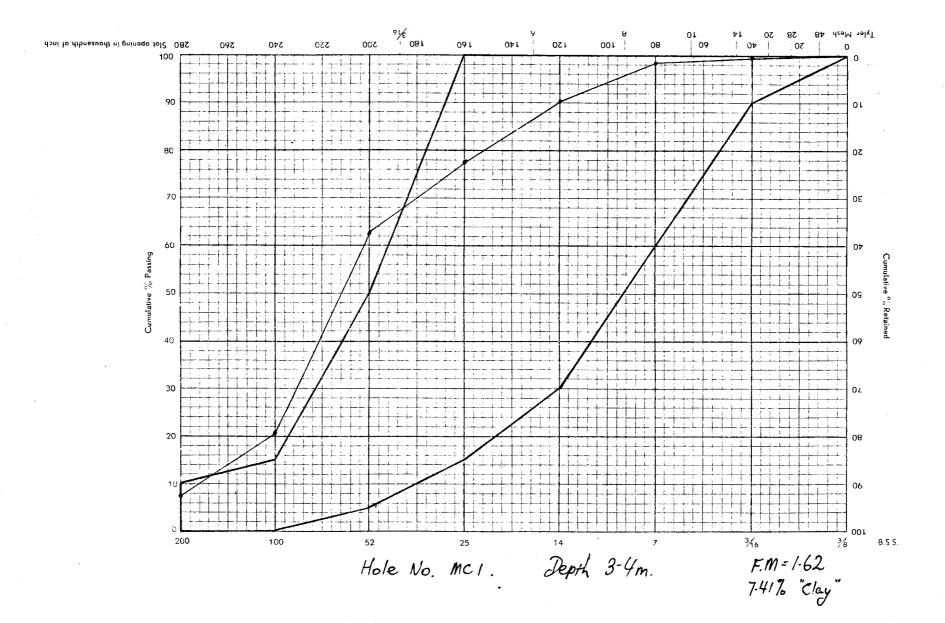


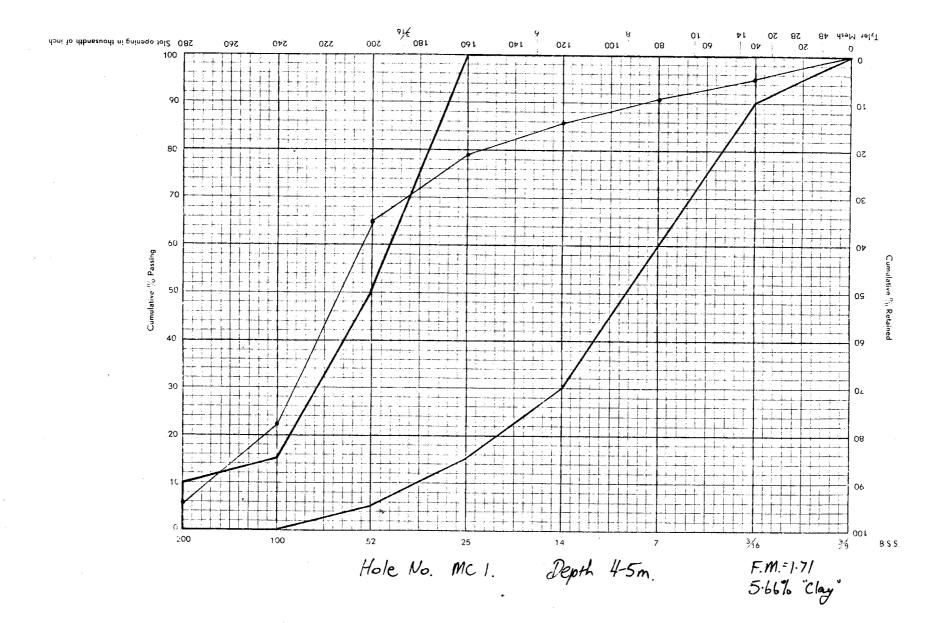
Hole No. CI 11

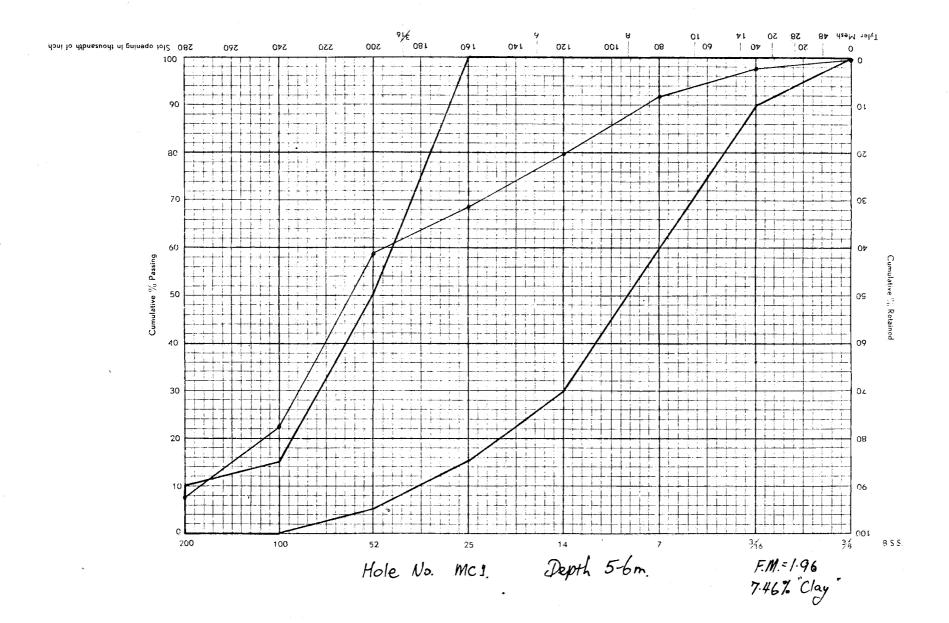
Depth 14-15m

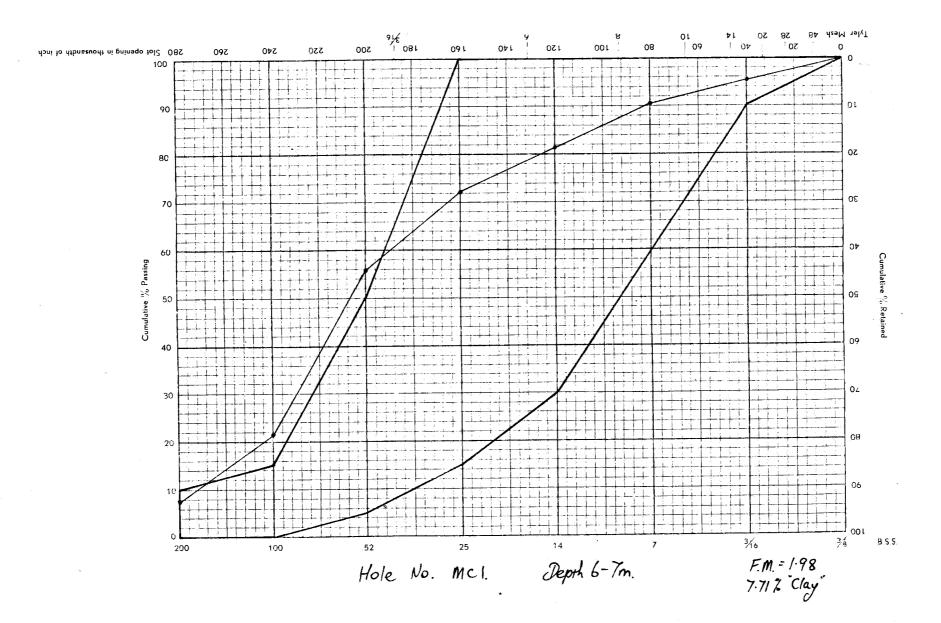
F.M.=1-86 11-95% "Clay."

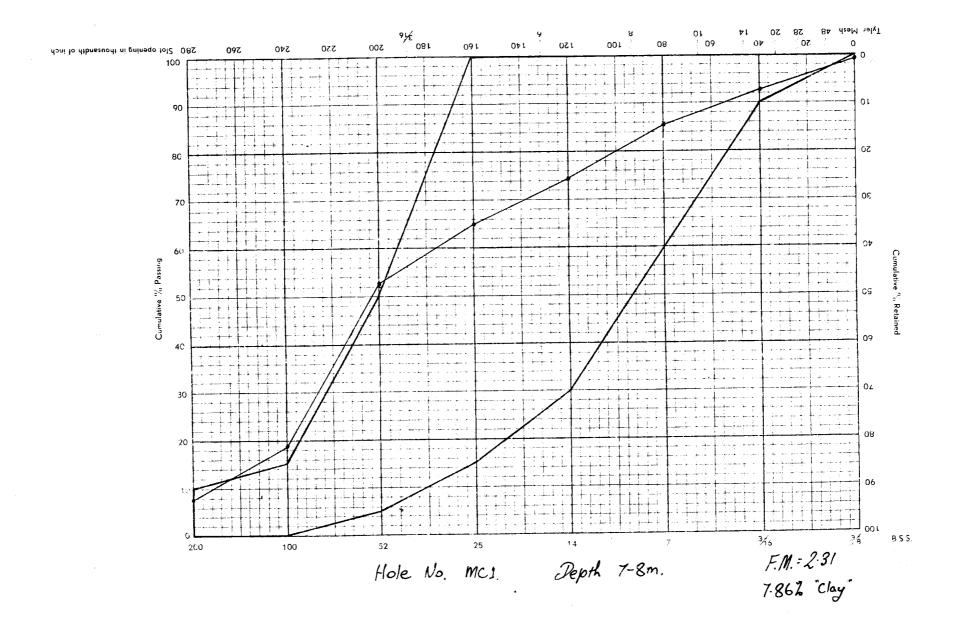


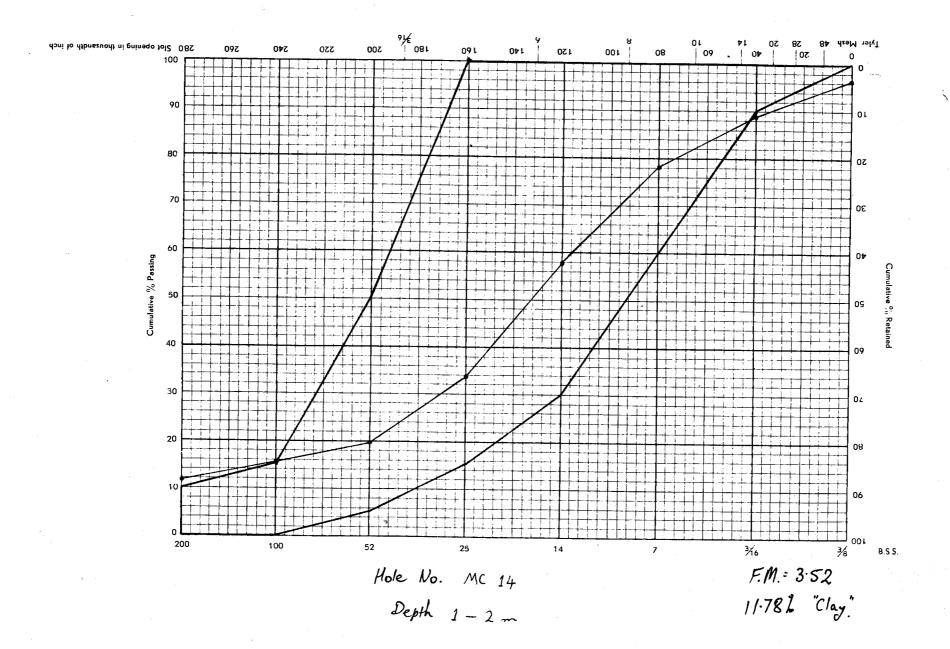


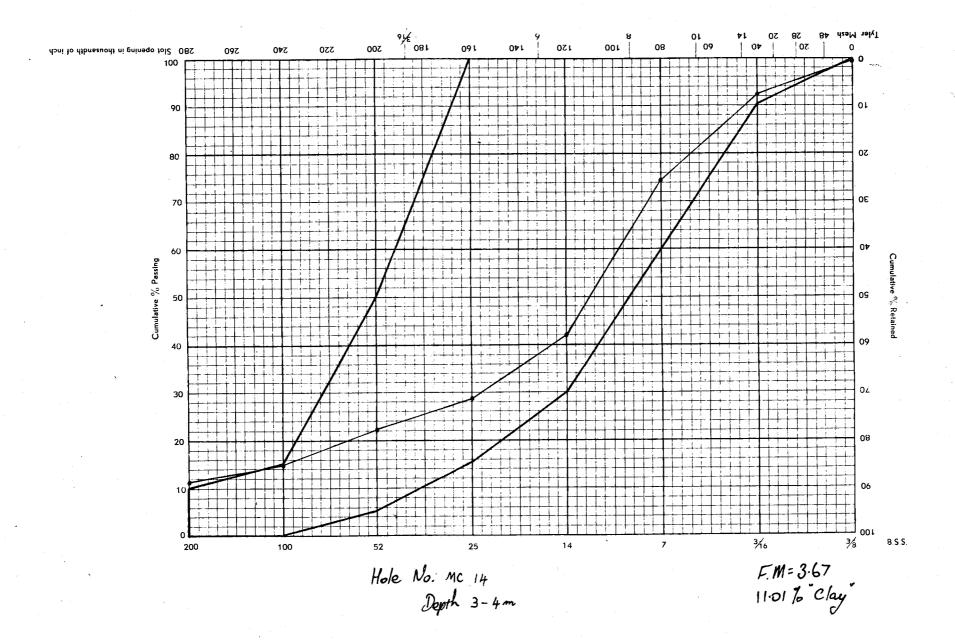


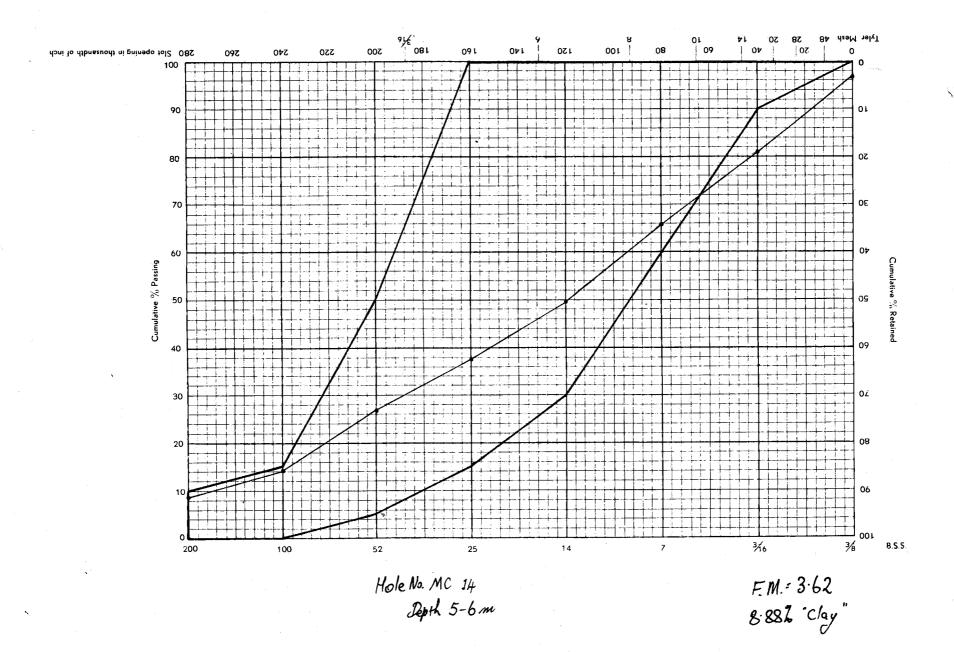


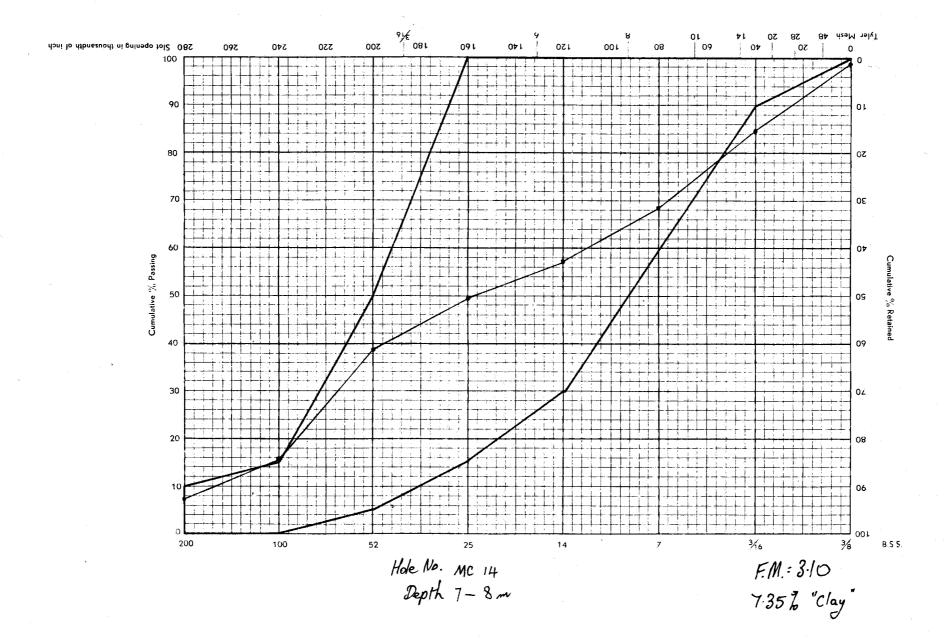


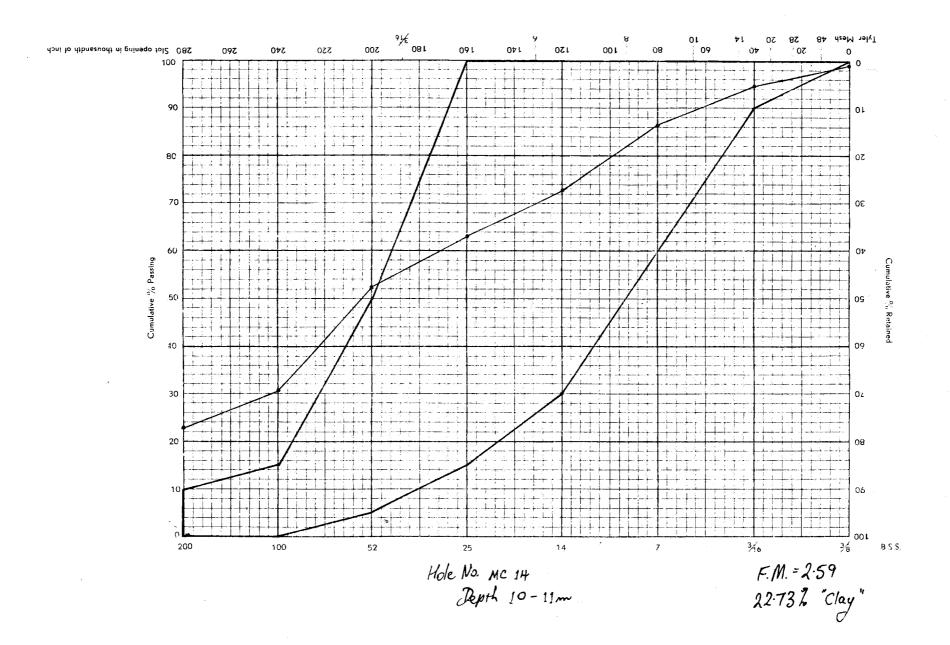


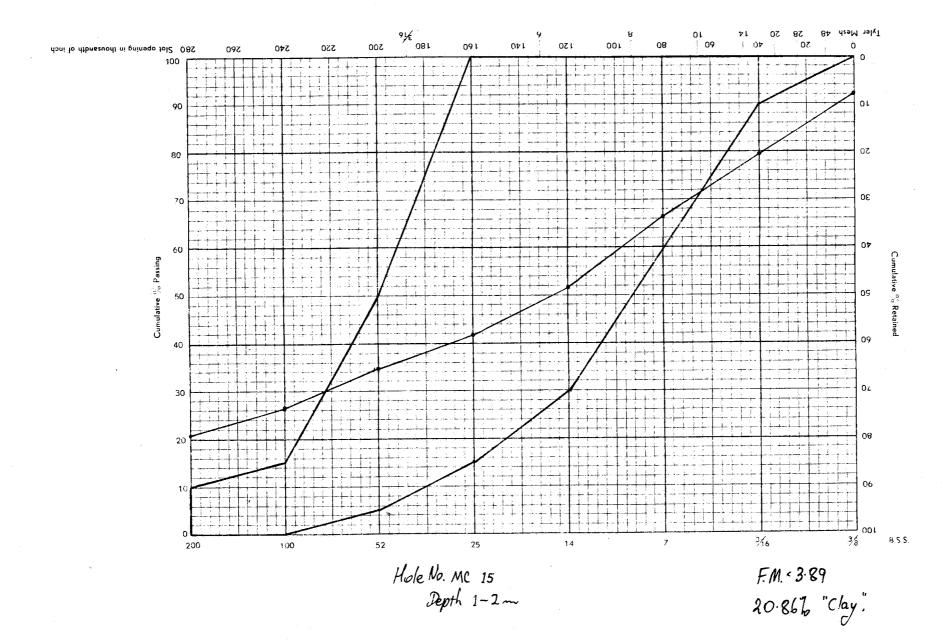


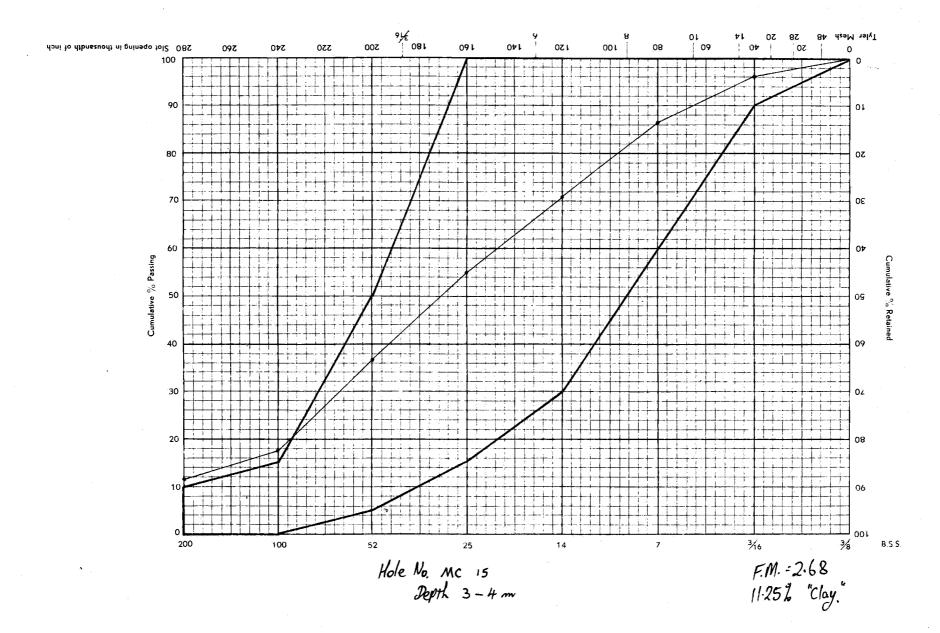


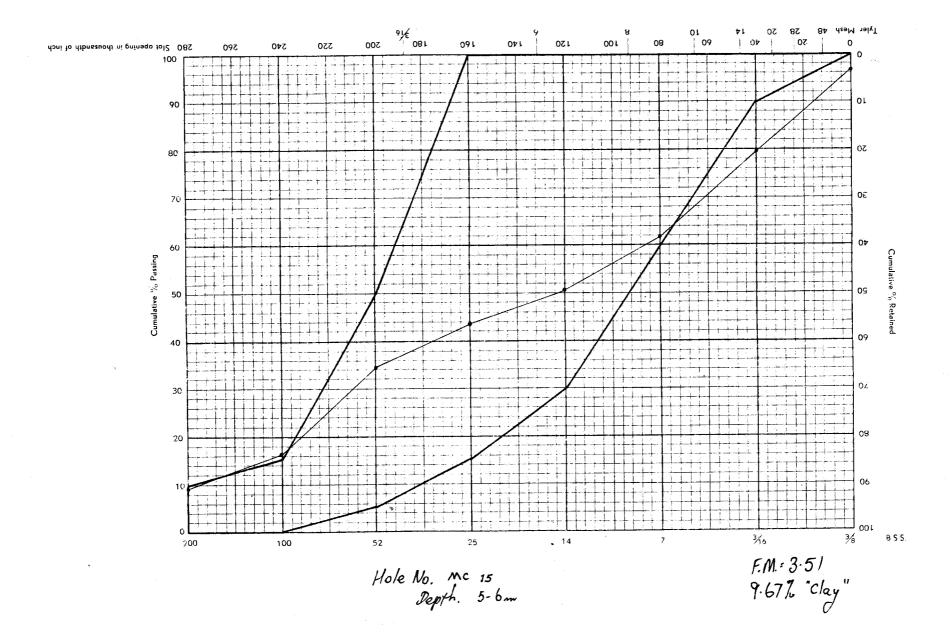


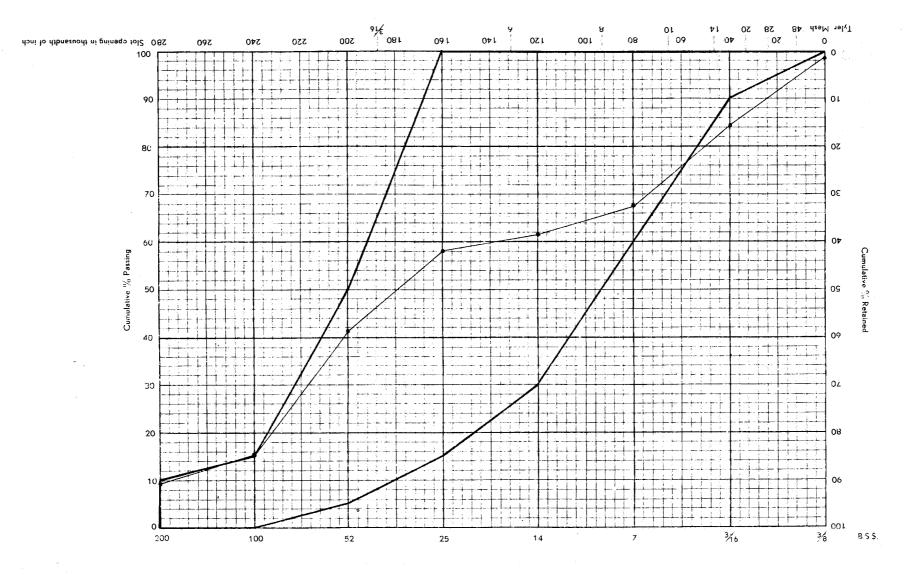






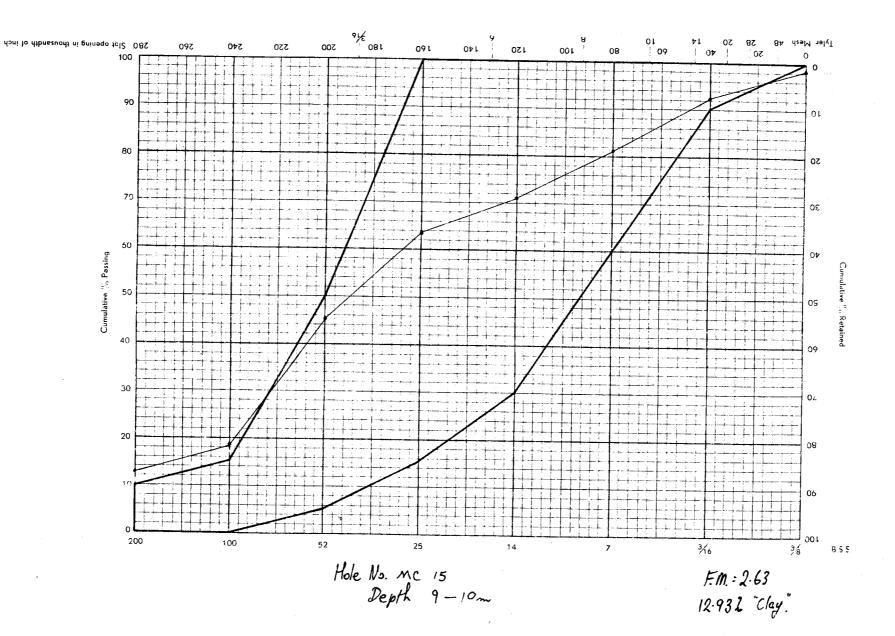


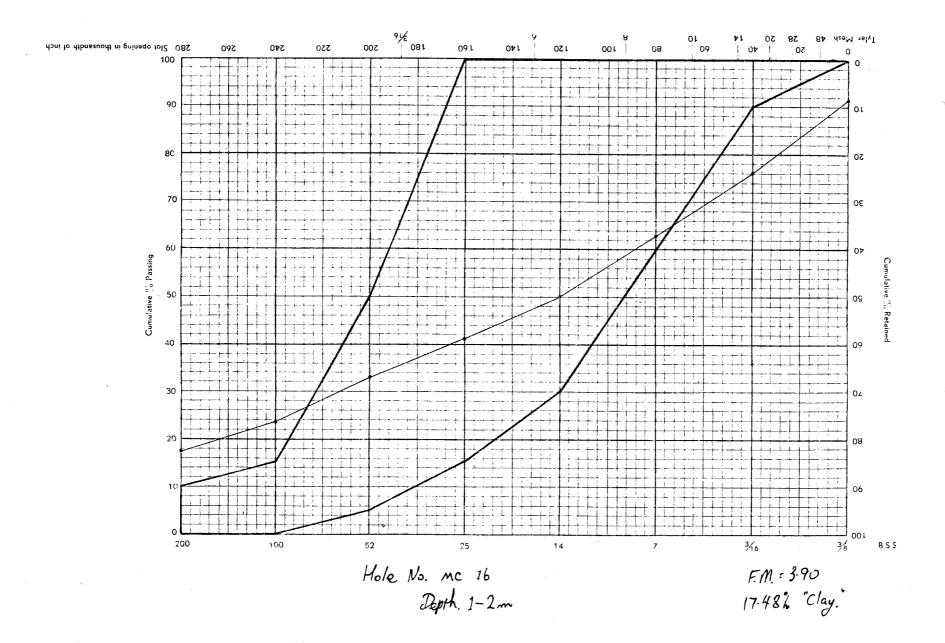


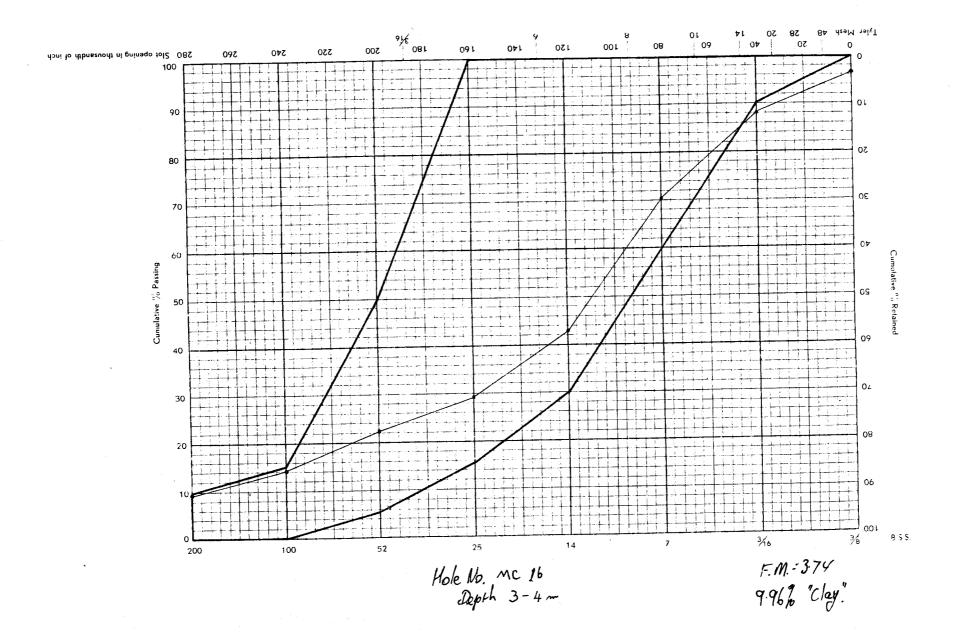


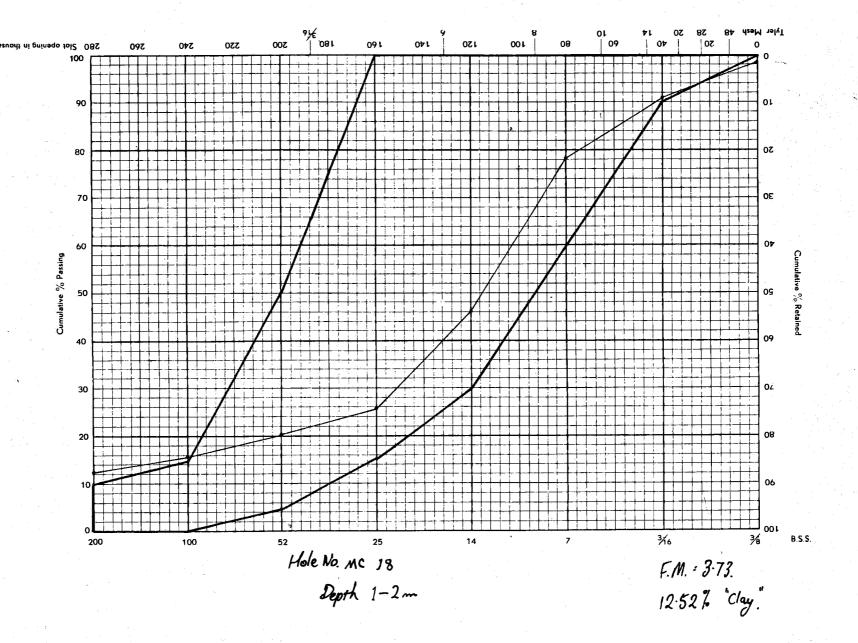
Hole No. MC 15 Depth 7-8m

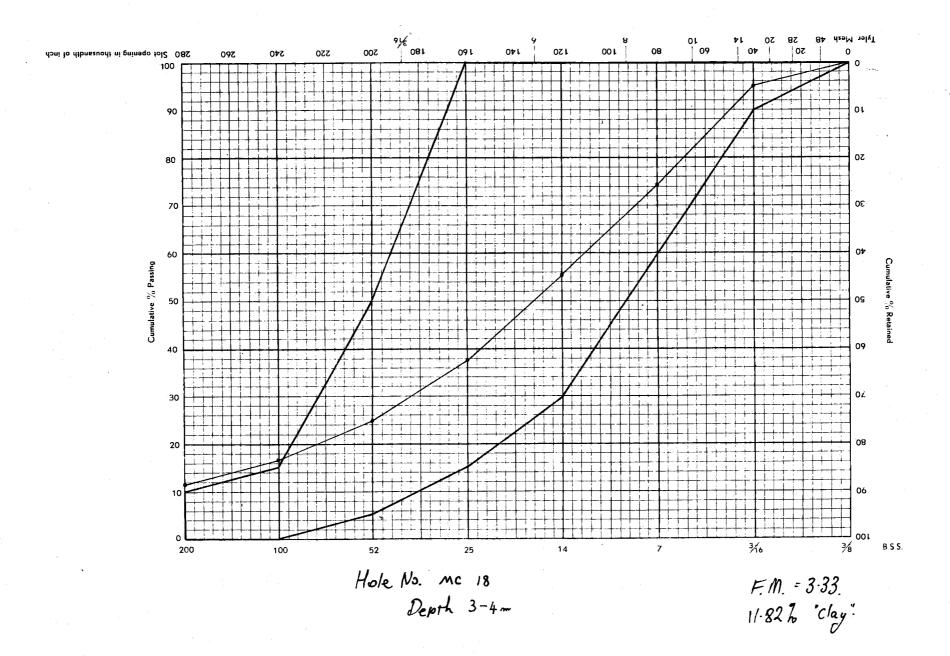
F.M.: 3.02 9.676 Chay

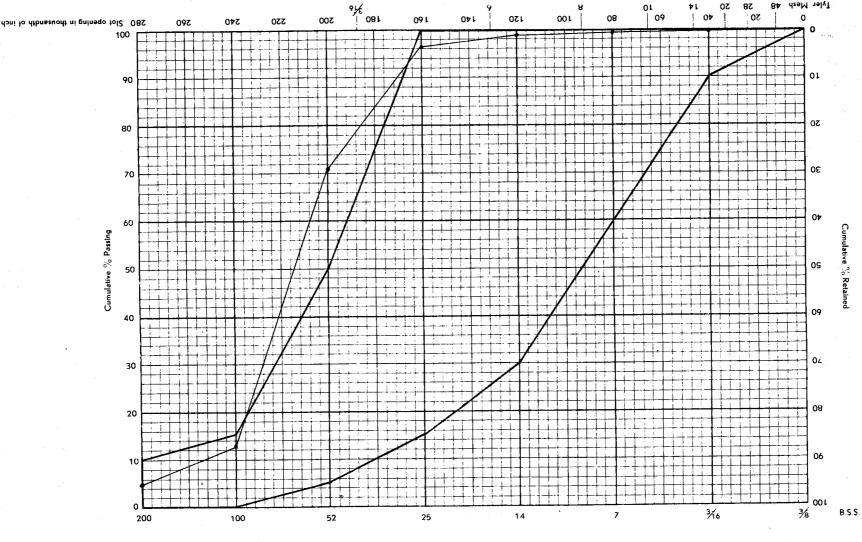






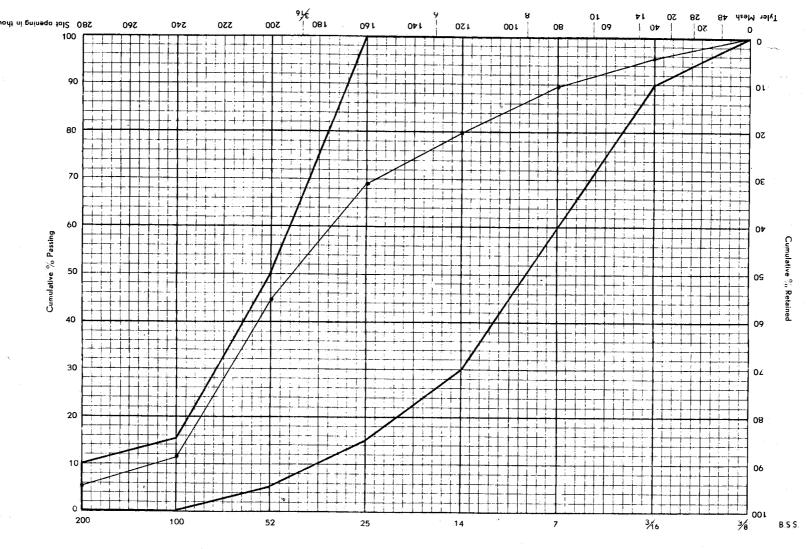






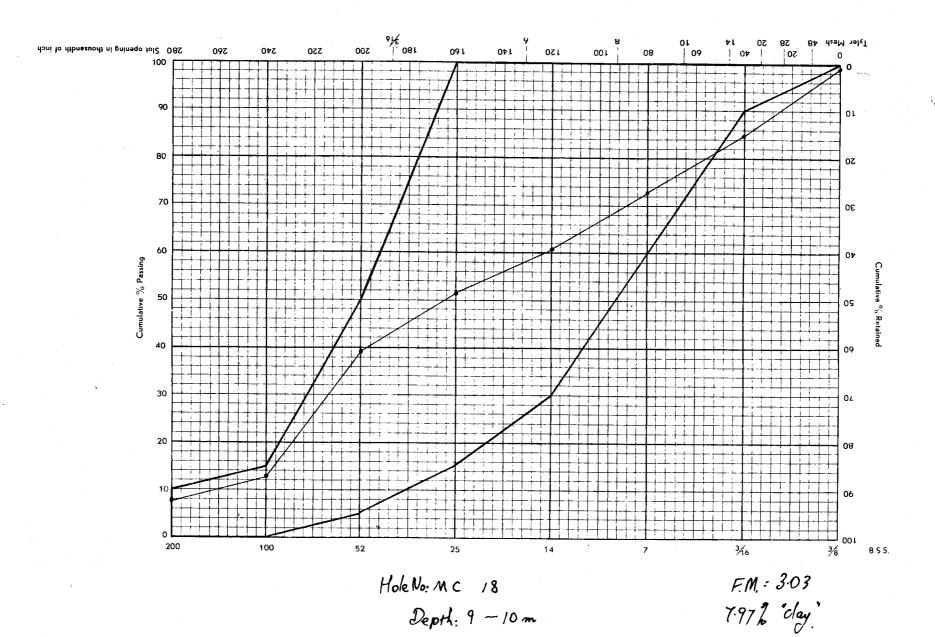
Hole No. Mc 18
Depth 5-6m

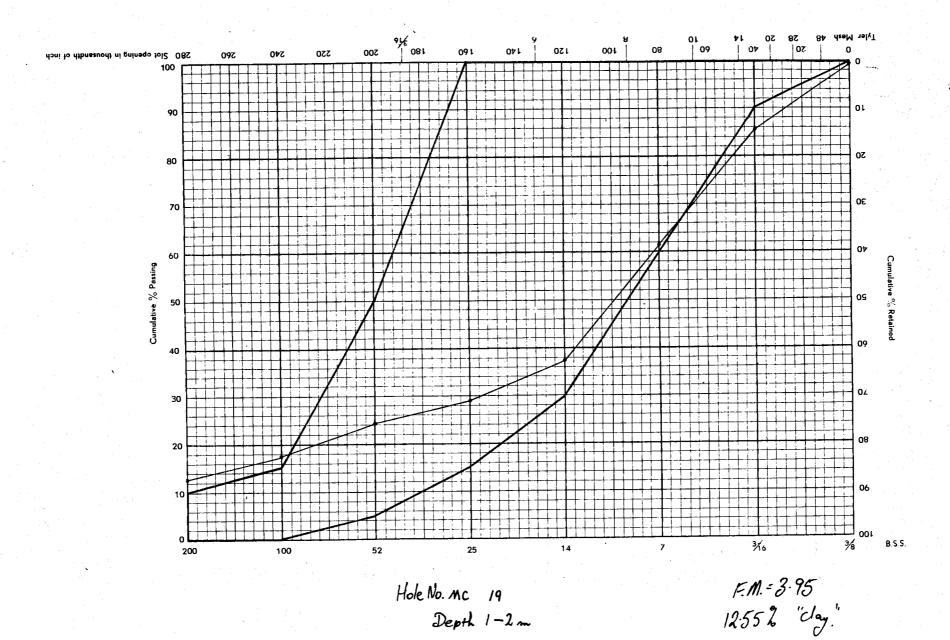
F.M.=1.28 4.78% "Clay".



Hole No. Mc 18 Depth 7-8m.

F.M. - 2.22 5.632 'Clay'





APPENDIX III

Petrographic Descriptions.

AMDEL REPORT N.P. 1268/75

Investigation and report by Dr. P.G. Moeskops.

Sample P214/74; TS 32902 Hole No. CI1 * Depth 1-2m

Rock Name:

Poorly sorted, clayey quartz gravel.

Hand Specimen:

Gravel to sand sized clasts of quartz and minor feldspar associated with minor amounts of clay and calcrete.

Thin Section:

An optical estimate of the constituents gives the following:-

respective to the second of t	70
Quartz	75
Feldspar	10
Clay	5-10
Calcrete	- 5
Muscovite	2-3
Opaques	1-2

clasts are angular to subrounded in shape and range in size from 0.01 nm to 2 cm although the majority are 2-4 mm in diameters.

Most of the feldspar is fresh microcline although the section also contains traces of fresh orthoclase and some sericitized plagioclase.

A small proportion of the clasts (?1-2%) consist of fine angular quartz grains cemented by limonite-stained calcrete.

Clay and calcrete together constitute a small proportion of the aggregate and the latter is mainly very finely divided and intimately mixed with the clay, although a few clasts are partially coated by calcrete and clay.

The aggregate contains 2-3% muscovite mainly as 0.1 - 0.5mm long flakes associated with free clay.

When the free clay, mica and fine calcrete are washed out of the material the remaining clasts should contain only a small amount of adhering calcrete and clay (1-2% max.), hence after washing the material will probably be suitable for use in concrete sand.

Sample: P215/74; TS 32903 Hole No. CI1 Depth 5-6m

Rock Name:

Sandy gravel.

Hand Specimen:

Clay-coated silt to gravel sized quartz clasts.

Thin Section:

An optical estimate of the constituents gives the following:-

Quartz Clay Feldspar Accessories; including tourmaline, muscovite.

trace

Clasts are angular to subangular and range in size from 0.1 to 6 mm, although he majority are 2 - 4 mm long. Clasts are typically coated by brown clay; however, most of this is liberated simply by washing.

The section contains traces of feldspar, muscovite and tourmaline.

The material is suitable for use in concrete sand.

Sample: P216/74: TS 32904 Hole No. MC1 Depth 4-5m

Rock Name:

Gravelly sand.

Hand Specimen:

quartz sand containing a few large quartz clasts plus minor amounts of clay, calcrete and muscovite.

Thin Section:

An optical estimate of the constituents gives the following: -

Quartz 95
Clay 2-3
Calcrete 2-3
Muscovite and other
accessories; (heavy mineral
grains)

This is a relatively clean and well-sorted quartz sand composed largely of angular 0.5 to 1.0 mm sized quartz grains which are thinly coated with clay and calcrete. About 5-10% of the sample consists of 3-10 mm sized clasts.

The section contains a few grains composed of fine quartz cemented by calcrete; however, overall the proportion of calcrete is low. Non adhering muscovite flakes constitute the main accessory mineral and there are a few opaque and other heavy mineral grains.

The material is most probably suitable for use in concrete sand.

Sample P217/74; IS 32905 Hole No. MC18 Depth 5-6m

Rock Name:

Quartz sand.

Hand Specimen:

Clean, well-sorted quartz sand.

Thin Section:

An optical estimate of the constituents gives the following: -

Quartz 98
Clay 1-2
Muscovite trace

This is a clean, well-sorted quartz sand composed almost entirely of angular, 0.2 - 0.5 mm sized quartz grains. A few larger (1-3 mm) quartz grains are present and most grains are very thinly coated with clay (mainly removed by washing). The main accessory minerals are muscovite and iron oxide grains.

The material is suitable for use in concrete sand.

Sample P218/74; TS 32906

Hole No. MC 15 Depth 1-2m

Rock Name:

Calcreted clayey-gravelly quartz sand.

Hand Specimen:

Poorly sorted calcreted, clayey gravely quartz sand.

Thin Section:

An optical estimate of the constituents gives the following: -

	%
Quartz (1991)	55
Clay	25
Calcrete	15
Teldspars	2-5
Accessories (mainly	
muscovite)	1

Clasts are angular to rounded and range in size from 0.01 - 10 rm; however, the majority are about 1 - 2 mm long.

Calcreted clay forms a moderate proportion of the clasts and adheres strongly to the smaller (0.5 - 2 mm) grains.

The Section contains minor amounts of relatively fresh feldspar (mainly microcline) and accessory muscovite.

*Because of the presence of calcrete clasts and because much of the adhering calcreted clay on quartz and feldspar clasts could not be removed by washing the naterial is unsuitable for use in concrete sand.

*Geologists Note. The calcrete clasts described from this thin section are most likely to be contaminants from higher in the hole; consequently sand from this depth (1-2m) is probably quite useable.

Sample P219/74; TS 32907 Hole No. MC15. Depth 5-6m

Rock Name:

Gravelly quartz sand.

Hand Specimen:

Poorly sorted gravely quartz sand containing traces of clay and calcrete.

Thin Section:

an optical estimate of the constituents gives the following:-

Quartz Clay Calcrete

Muscovite and other accessories trace

Clasts are subrounded to angular and range in size from 0.01 mm to 12 mm; however, the majority are 0.3 to 0.5 mm long.

Calcrete and clay mainly occur as thin coatings on clasts, although some clay is free and can be easily removed by washing.

The material is most probably suitable for use in concrete aggregate.

ADDITIONAL NOTES

- All samples contain traces of ferricrete, tourmaline and dark (?) organic material.
- Addition of dilute HCl to the samples gives the following b)

Sample

\mathbb{R} esponse.

P214/74 P215/74 P216/74 P217/74 P218/74 P219/74

Moderate effervescence Very slight effervescence Very slight effervescence. No effervescence Very intense effervescence Very very slight effervescence

APPENDIX IV

Reserve Calculations (including plan 74-1009)

SECTION 107

HOLE NUMBE	R	MC 18	MC 17	MC 14	MC 23	MC 19	MC 20	MC 15	MC 16	MC22	MCI	TOTAL
AREA OF INFL	UENCE (m²)	4,450	4,300	3,050	5,750	3,250	4,550	3,825	3,650	5,100	275	-
OVERBURDEN	DEPTH (m) VOLUME (m³)	1·0 4,450	1·0 4,300	0·3 920	1·5 8,630	1·0 3,250	1·0 4,550	0·4 1,530	1·0 3,650	1·5 7,650	1·5 410	39, 340
COARSE SAND	DEPTH (m) VOLUME (M³)	8·5 37, 830	13·5 58,050	10·7 32,640	4·0 23,000	0·8 2,600	4·0 18,200	10·4 39,780	3·5 12,780	3·5 17,850	3·3	- 243,640
FINE SAND	DEPTH (M) VOLUME (M³)		<u>-</u>			-	_		-	-	4·0 1,100	1,100
WASTE	DEPTH (m) VOLUME (m ³)	2·0 8,900	- -			<u>-</u>	-			_ _	_	8,900

ROAD

HOLE NUMBER	CII	MC 18	MC 17	MCI	MC 23	TOTAL	
AREA OF INFL	3,650	825	1,250	3,200	1,050	_	
OVERBURDEN	DEPTH (m) VOLUME (m ³)	1·0 3,650	1·0 830	1·0 1,250	1·5 4,800	1·5 1,580	12,110
COARSE SAND	DEPTH (m) VOLUME (m³)	12·0 43,800	8·5 7,010	13·5 16,880	3·3 10, 560	4·0 4,200	- 82,450
FINE SAND	DEPTH (M)	<u>-</u>	-	_ _	4·0 12,800		_ 12,800

COMBINED VOLUME TOTALS Overburden 123,500 m³ Coarse construction sand. 464,000 m³ Fine construction sand.... 187,000 m³

Waste 9,000 m³

MONARTO CONSTRUCTION SAND INVESTIGATION

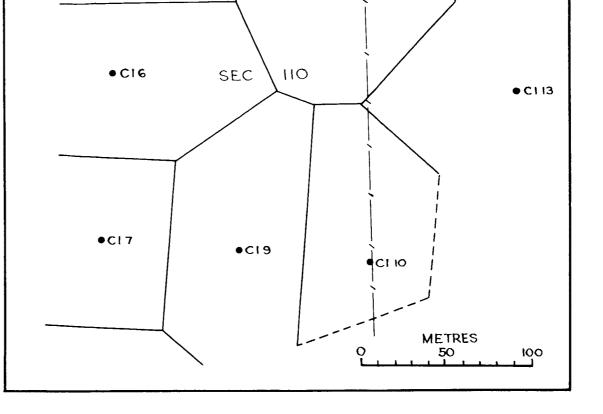
TEPKO SAND DEPOSIT

RESERVE CALCULATIONS

COMPILED BY A M. PAIN

SECTION 110

HOLE NUMBER	CII	MC 17	мст	CHI	CI 10	MC 23	TOTAL	
AREA OF INFLUEN	CE (m²)	3,550	40	3,300	14,000	8,500	20	_
OVERBURDEN DEPT	H (m) ME (m³)	1·0 3,550	1·0 40	1·5 4,950	1·5 21,000	5·0 42,500	1·5 30	_ 72,070
COARSE SAND DEPT	ме (m³)	12·0 42,600	13·5 540	3·3 10,890	6·0 84,000	_ _	4·0 80	138,110
FINE SAND DEPT	н (m) ме (m³)	_		4·0 13,200	9.0 126,000	4·0 34,000	<u>-</u>	173,200



• MC 16

• MC15

• MC 14

● MC I

♦CI II

107

• MC 22

MC 23

• MC 19

• MC 18

•C15

• MC 20

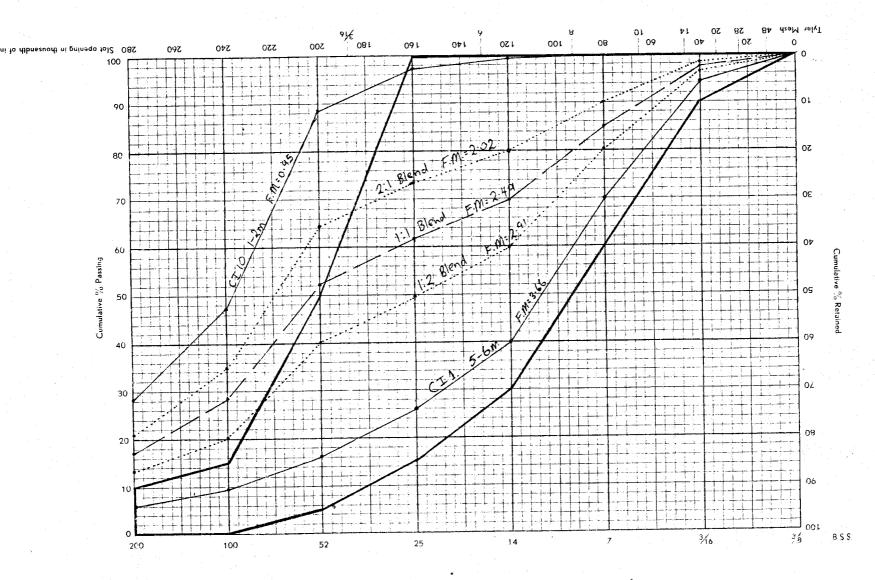
SEC

• MC 17

ROAD

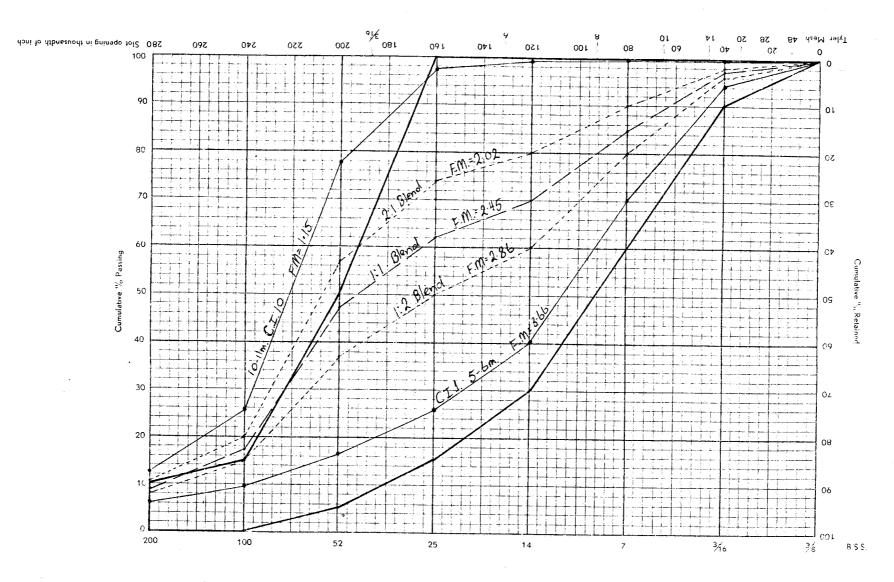
APPENDIX V

Examples of Blending Coarse and Fine Material



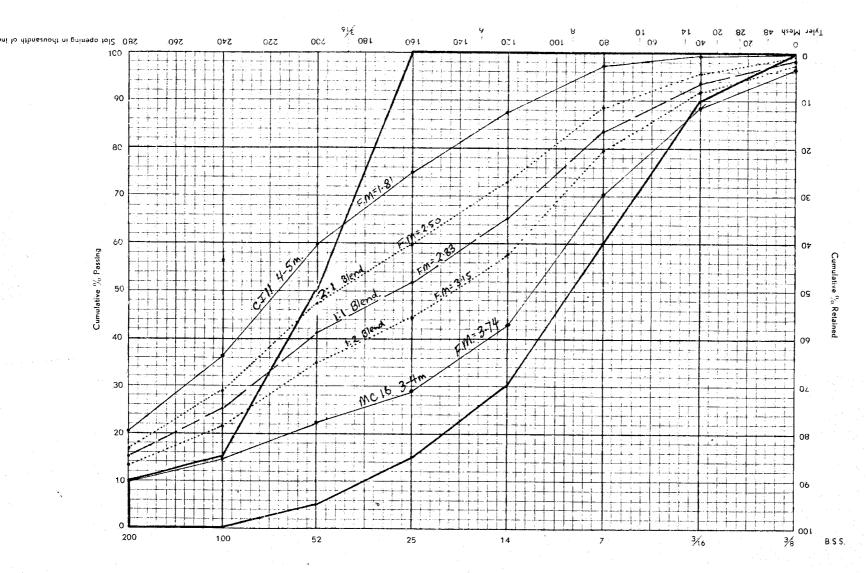
Size gradings obtained by blending CIIO 1-2m with CII 5-6m.

Note that CIIO 1-2m. is outside A77 envelope, but blending can produce useable materials.



Size gradings obtained by blending . CIIO; 10-11m. with CII 5-6m.

Note that CIIO 10-11m. is outside the ATTenvelope, but blending can produce useable materials.



Size gradings obtained by blending CIII; 4-5m. with MC16; 3-4m

