Open File Envelope No. 1140

POINT PATERSON – PORT PIRIE AREA

PROGRESS REPORTS ON WORK CARRIED OUT PRIOR TO GRANT OF A SPECIAL MINING LEASE, FOR THE PERIOD JUNE 1962 TO NOVEMBER 1969

Submitted by
Delhi Australian Petroleum Ltd
1969

Enquiries: Customer Services Branch
Minerals and Energy Resources
7th Floor
101 Grenfell Street, Adelaide 5000

Telephone: (08) 8463 3000
Facsimile: (08) 8204 1880

Government of South Australia
Primary Industries and Resources SA

CONTENTS ENVELOPE 1140

TENEMENT: S.M.L. 375

TENEMENT HOLDER: Delhi Australian Petroleum Ltd.

REPORT:

E.W.S. 2023/62.

AUGUSTA SALT CO.

Comments on soil sampling, testing and logging, and abbreviations used.

Sampling - on embankment lines

The location of bore sites was agreed on at a conference between Messrs. Rawlinson and Fleming on 29th May after an inspection of the area by Messrs. Boyd (Mines Department) and Fleming. It was expected, at that time, that some relocation may be necessary because of difficulty of access at some locations. Generally all holes were drilled as planned.

For the early holes, solid tube samples were taken from the surface downwards into obviously impermeable material, but as the geology of the area became clearer, sampling of the top 8 to 10 feet generally was done only where variations of material showed.

Logs of all holes drilled are attached. In addition the Department of Mines has logged the holes.

It should be borne in mind that in the descriptions given by this Department, "clay" indicates the presence of clay minerals, whereas in the report by J.G. Olliver, it indicates the geological meaning of fraction smaller than 5 or 6 microns. There is actually very little evidence of clay mineral in the area examined, but the silt or rock flour is very fine - certainly to less than 1 micron.

Sampling - on borrow areas

Almost the whole of the sampling of the borrow areas was done under the direction of a Geologist of the Department of Mines, a few holes only being sampled by Mr. Rawlinson. Representative samples of the area were tested in the E. & W.S. Dept. laboratory and results are attached (See also Geological Report by J.G. Olliver - Appendix II).

Testing

All engineering tests on the soil samples were performed in this Department's Soils Laboratory in accordance with procedures of B.S.S. 1377-1961 or where a test is not covered by this Standard, in accordance with the relevant A.S.T.M. Standard. B.S.S. Standard procedures agree very closely with A.S.T.M. tests and generally, the same results can be expected from both Standards.

Wherever sufficient material was supplied from a hole, individual tests were done, but where the samples were too small similar materials were mixed and the tests done on the mixture. Also, where it was known at the time that samples were from the same area, composite tests were done.

Logging

The logs of test bores attached are unconsolidated field records and there is an entry for every sample received. Normally these would be rewritten to give a better picture of the conditions in situ and the variation of material. Because of shortage of staff this has not been possible.

Trial Bank Core

Work in connection with the trial placement of the below ground portion of a bank was witnessed on July 16th to 18th. Although considerable difficulties were experienced because of lack of appreciation by the contractors of the requirements of the work and also due to poor organisation on their part in the early stages, that portion of the work done on the third day was of satisfactory quality to provide an effective water barrier for the project.

Generally, the test work provided proof of the practicability of the methods proposed for the construction of the banks and cut off, and a very satisfying compaction was achieved even with the equipment available. In situ densities were later checked by sampling and results varied between 98 and 112 p.c.f. dry weight with a mean of 106½ p.c.f. or 93% of standard compaction. At this density the permeability of the material should be less than 10×10^{-4} cm. per sec. and with the main construction work properly organised and with more suitable equipment, this should reduce to approx. 1×10^{-4} cm. per sec.

Abbreviations used.

C Cohesion in pounds per sq. in.

Dc Percentage by weight finer than 0.002 mm. (clay size).

DDm Maximum dry density, pounds per cubic foot - 5½ lb. hammer, 12" fall.

Ds In situ dry density in pounds per cubic foot.

D90 Particle size in mm. of which 90% of sample is finer.

LC Lime content as percentage of dry weight of material finer than 2.4 mm. (No. 7 Sieve).

LL Liquid Limit.

MC In situ moisture content at date of sampling, in per cent of dry weight.

OMC Moisture content at DDm in per cent of dry weight.

PI Plasticity index.

PL Plastic limit.

SL Shrinkage limit.

SR Shrinkage ratio.

WD In situ wet density in pounds per cubic foot.

Ø Angle of friction. Note:- For high moisture contents the values of C and Ø are for "quick undrained" tests.

AUGUSTA SALT CO.

Summary of tests on samples from trial bank core.

Hole	Depth	WD	DS	MC	LC	LL	PL	PI	SL	SR	D90	Dc	OMC	MDm	Ø	C
ML 142-1	0'3" - 1'-0"	130	112	16	16											
-2	1'9" - 2'3"	129	109	18	19	31	14	17	15	1.84	0.34	26				
-3	2'11" - 3'4"	121	98	20	10											
-4	4'4" - 4'9"	129	109	18	21											
-5	5'8" - 6'1"	131	111	18	-											
-6	6'10" - 7'3"	124	104	19	17	31	14	17	15	1.83	0.37	24				
-7	7'6" - 7'11"	126	107	17	19											
-8	8'9" - 9'2"	126	105	20	19	30	13	17	15	1.81	0.37	25				
-9	9'8" -10'1"	126	104	21	20											
	Mixture of all above												14	115	13°	21
Summary of samples from Grid No. 11 (Drg. L62-132)																
Group A	Holes located by Mr. Rawlinson															
10	0 -10'0"			13	24											
11	0 -10'0"			14	22											
12	0 - 8'0"			19	25											
13	0 -10'0"			17	27											
15				32	24											
	Mixture					40	19	21	15	1.84	.20	27	21*	104*		
						36	16	20	12	1.90		29	16	110		
Group B	B.T.S.A. Pole No. North of Borrow Pit															
30				17	13											
35				17	11											
46				17	8											
	Mixture					46	18	28	13	1.93	.17	33	21	103		
Group C	Between road corner and first gate															
12D 200S	6'0" -10'0"			16	20	36	14	22	13	1.88	.32	34	16	112		
12D 400W	1'0" - 3'0"			42	16	45	17	28	16	1.79			22	102		
13B 200S	2'0" -10'0"			18	3	46	16	30	13	1.91			21	104		
	Ungrouped															
4L	6'0" -18'0"			18	19	40	14	26	12	1.96	.26	34	17	109		
5L	18'0" -24'0"			21	14	51	16	35	12	1.98	.24	40	18	106		
6A	2'0" -34'0"			22	10	38	13	25	12	1.94	.28	41	17	112		
6G	0 -24'0"			18	14	43	15	28	12	1.92	.27	39	18	108		
Samples from Grid No. 37 (Drg. 62-593)																
1 (A200W)	0 -10'0"			18	11	34	13	21	11	1.96	.22	32	16	111		
3 (S of Pit)	0 -10'0"			14	18	39	15	24	13	1.90	..26	32	16	110		
4 (100'S. of Pit)	0 -10'0"			20	11	54	15	39	13	1.90	.22	42	21	104		
46				See Group 'B' above												
Sample from Southern Lease																
S1	0 -10'0"			21	26	35	16	19	14	1.88	.33	30	16	112		

* = Harvard

MINUTES forming ENCLOSURE to E.W.S. *No.* 2023/62.

THE ASSISTANT ENGINEER FOR DESIGN:

The information requested by Augusta Salt Ltd., in their letter of 30th June, so far as work has proceeded to date is as follows.

1. Main North Bank

This is the embankment referred to in the latter part of my minute of 7th June. This has been discussed with Messrs. Rawlinson and Lopez. For convenience this portion of the minute is repeated viz.,

"At the time of this last visit, the question of strengthening the main embankment was raised by both Messrs. Rawlinson and Lopez, and my opinion sought on the best approach to the work. From a visual examination of the bank and taking cognizance of its history, three alternatives were suggested.

1. Use existing bank as cofferdam and build new embankment immediately inside of it.

2. Very extensive field investigations followed by any remedial work required plus additional strengthening.

3. Accept existing bank as probably stable. Flatten side slopes by the addition of more silt placed as well as possible in the water, followed by a filter and rock blanket.

Of these the first is the most positive, and the third the cheapest in first cost, but involves a risk of failure somewhere along its length.

It was suggested that the third alternative might be adopted but bearing in mind the possibility of the risk. This appealed to Messrs. Rawlinson and Lopez as the most desirable from their point of view, and they are now to check sources of supply of filter sand and stone for pitching."

Further examinations of the embankment and consideration of the work confirms my earlier views that the third alternative is the correct solution.

An additional safeguard has been suggested to Messrs. Rawlinson and Lopez, viz. the relocation of banks or rearrangement of ponds to provide an area capable of being isolated from the remainder of the works should repairs become necessary to the main bank. A sketch showing this general idea is attached, but the actual area to be enclosed should be determined by the Company to suit ease of operation.

2. Core samples

Samples have been received at irregular periods for the following holes, locations of which were determined at a conference between Messrs. Rawlinson, Lopez and myself, viz. Bores Nos. 1 to 10, 11 + 500E, 11A, 12 + 200E, 13-16, 22-31, 34-41, 43-45, 49, 50.

These represent the whole of the samples received at Thebarton Depot to date. Photo copies of field notes are attached. It should be remembered that these logs present a description of a megascopic examination of the samples from 4" percussion bores and there is an entry for every separate sample length received. Numbers represent the numbers of blows to achieve the penetration shown. The following abbreviations have been used:-

Imp. = impermeable	less than 0.5 x 10^{-4} cm/sec
Rel. imp. = relatively impermeable	approx. 10 x " "
Low perm. = LP = low permeability	" 100 x " "
Mod. P. = moderate permeability	" 1000 x " "
P = permeable	" 20000 x " "

Permeability codes have been used to cover the requirements of the job.

3. Perimeter Levee

a. The logs of the bores indicates the depths at which material of sufficiently low permeability occurs. The red, slightly clayey silt, in almost every case examined, should have a 'K' value of less than 10^{-4} cm/sec. and the answer to the question is that the red 'clay' bottom is expected to be satisfactory (none of this material has been located which is unsatisfactory).

b. Imported fill. At present no information is available in this office showing the extent of borrow area represented by different samples. Some of the material is satisfactory - other is deficient in fines to provide a satisfactory barrier.

Results of tests on the samples provided by the Mines Department are attached.

Tests are being made at present to obtain data to enable some prediction of the time - permeability properties of the suitable fill placed under water with the construction procedure proposed. It will be several weeks before an answer can be given on this.

The inspection of the trial placement, on 16th-18th July indicated that with the proper material (later material used on test) a satisfactory water barrier can be built by the process proposed.

H D Fleming

DESIGNING ENGINEER.

HDF:HB
2/8/62.

AUGUSTA SALT WORKS.

BORE NO. 1.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-1'0"	Light brown silt.			
1'0"-2'0"	Very fine sandy silt, light brown.			
2'0"-3'0"	Fine sand, some silt, shelly.			
3'0"-4'0"	" " , less silt, fewer shells.			
4'0"-10'0"	" " , " " , few shell fragments.			
10'0"-11'6"	Grey med. silty sand, shelly, some organic matter.			130
11'6"-12'6"	Med. grey shelly silty sand with clean med. sand pockets.			60
12'6"-15'0"	Grey silty med. sand, appreciable shell fragments.			100
15'0"-16'0"	Grey silty med. sand grading to med. sandy silt - shell			40
16'0"-17'0"	Grey silty med. sand to 16'6", thence yellow very fine sandy silt, small shells.	Imp. 16'6"		45
17'0"-18'6")	Brown very slightly clayey			160
18'6"-20'0")	silt.			375
20'0"-21'0"	Med. white sand, very small shell fragments grading to red silt (6" perm. layer)			300
21'0"-26'0"	Brown clayey silt becoming mottled at bottom.			21'-22' 160 22'-23' 155 23'-24' 85 25'-26' 35
26'0"-27'6")	Mottled brown grey-blue clayey			26'-27'6" 65
27'6"-30'0")	silt.			27'6"-29' 85 29'-30'0" 90

BORE NO. 2.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-1'0"	Yellowish very fine sandy silt with fine shell fragments.			20
1'0"-2'0"	Light brown fine sand, appreciable shell fragments.			30
2'0"-9'0"	Med. sand, light brown, appreciable shell fragments.			
9'0"-10'0"	Med. grading to coarse light brown sand, shell fragments.			
10'0"-11'6"	Light brown medium sand, very apprec. shell fragments.			
11'6"-12'0"	Blue-grey silt, very soft.			
12'0"-13'0"	" " " grading to light brown fine silty sand.			90
13'0"-14'0"	Light brown fine sandy silty clay, some small stones.	Imp.		
14'0"-15'0"	Light brown to yellow brown silty fine sand.	Low perm.		40
15'0"-16'0"	Light brown to yellow brown, grading to very fine silty sand, little clay.	"		45
16'0"-17'0"	do.	"		45
17'0"-18'0"	do.			
18'0"-19'6"	Brown silt.	Imp.		120
19'6"-21'0"	do.			285
21'0"-22'0"	Brown silt, fine sand layer 21'4".			85
22'0"-23'0"	Brown silt, clayey, very tough on drying.			80
23'0"-24'0"	Red-brown clayey silt.			
24'0"-25'6"	Brown mottled cream grey clayey silt.			160

AUGUSTA SALT WORKS.

BORE NO. 3.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-1'0"	Cream silt.			15
1'0"-2'0"	do.			5
2'0"-3'0"	Pale blue soft silt grading to fine silty sand.			4
3'0"-5'0"	Yellow to very light brown clayey silty fine sand.			20
5'0"-7'0"	Grey fine sand grading to blue-grey very fine sandy silt.	Imp.		
7'0"-8'0"	Blue-grey very fine sandy silt with veins of fine sand.			35
8'0"-9'0"	Blue-grey, changing to grey-brown silt - firm layers sand (fine).	Imp.		
9'0"-10'0"	Grey-brown silt grading to med. sandy silt.	Rel. Imp. at top		45
10'0"-11'0"	Brown very fine sandy silt.	Imp.		40
11'0"-12'0"	do.			45
12'0"-13'0"	Brown very fine sandy silt grading to brown silt.	Imp.		50
13'0"-14'0"	Brown silt, some small stones.			20
14'0"-15'0"	do.			40
15'0"-16'0"	Brown silt, some small stones, small patches light brown (calc.)?			45
16'0"-17'0"	do.			50
17'0"-18'0"	do.			55
18'0"-19'6"	Very compact brown silt.	Imp.	+	120
19'6"-21'0"	Very compact brown (some mottling grey) silt.	Imp.		110
21'0"-22'0"	Very compact brown grey mottled silt.	"		45
22'0"-23'0"	do.	"		45
23'0"-24'0"	Brown and blue-grey very fine silty sand.	"		30
24'0"-25'6"	do.	"	+	90

BORE NO. 4.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-1'0"	Cream shelly silt.			5
1'0"-2'0"	Shell. (95% shell).			3
2'0"-4'0"	Sandy shell. (2/3 shell).			60
4'0"-5'0"	Shelly fine sand. (2/3 sand).			20
5'0"-6'0"	Shelly fine sand. (1/5 shell).			10
6'0"-7'0"	Fine sand, slightly silty, some shell.			20
7'0"-8'0"	Blue-grey silty fine sand.			30
8'0"-9'0"	Grey silt.	Imp.		35
9'0"-10'0"	Brown silt.	"		30
10'0"-11'6"	Brown silt, lime, rich patches.	"	+	80
11'6"-12'6"	do.	"		25
12'6"-13'6"	Brown silt, less lime.	"		60
13'6"-14'6"	Brown silt.	"		55
14'6"-15'6"	Brown silt, lime inclusions very firm.		+	110
15'6"-17'0"	Light brown fine silty sand.	P.	+	50
17'6"-18'0"	" " fine sandy silt - calc.	Rel. Imp.		30
18'0"-19'0"	Yellow-brown mottled brown, blue-green very fine sandy silt.	"		35
19'0"-20'0"	Yellow-brown mottled brown, blue-green clayey silt.	"		45
20'0"-21'0"	do.	"		40
21'0"-22'6"			+	

AUGUSTA SALT WORKS.

BORE NO. 5.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-1'0"	Cream silt, few small shell fragments.			1
1'0"-3'0"	Light brown with creamy lime rich spots.			1
3'0"-4'0"	Grey fine silty sand - shelly.			6
4'0"-5'0"	do.			15
5'0"-6'0"	Fine to very fine sandy silt - shell.	Low perm.		12
6'0"-7'0"	Light greeny-grey silt with small shell fragments.	Imp.		15
7'0"-8'0"	do.	Imp.		10
8'0"-9'0"	do.	Imp.		15
9'0"-10'0"	do.	Imp.		15
10'0"-11'0"	Light greeny-grey silt with small shell fragments, becoming sandy at bottom.	Imp.		25
11'0"-12'0"	Light grey fine sandy silt grading to silty sand.			25
12'0"-13'0"	Light grey fine silty sand to 12'9"; 12'9"-13'0" brown silt.	Imp.		35
13'0"-14'6"	Brown silt.	Imp.	*	60
14'6"-15'6"	Brown silt, becoming mottled blue-grey creamy.	Imp.		30
15'6"-16'6"	Brown silt, less mottling, sand increasing.	Imp.		35
16'6"-18'0"	Brown silt, very little sand.		*	65

BORE NO. 6.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-1'0"	Cream silt, shell fragments.			10
1'0"-2'0"	Cream silt, increase shell.			12
2'0"-7'0"	Brown silt and organic shelly silt in patches, some sand.	P.		?
7'0"-8'0"	do.			12
8'0"-10'0"	Light grey fine silty sand with small shell fragments.	Perm. to Rel. Imp. ?		?
10'0"-11'0"	do.			?
11'0"-12'0"	Light grey fine silty sand - no shell.			?
12'0"-13'0"	Light grey fine silty sand - some shell.			?
13'0"-14'0"	Light brown silt.	Imp.		35
14'0"-17'0"	do. 14'0"-15'6"	"	*	?
	15'6"-17'0"		*	
17'0"-18'0"	Brown silt.	Imp.		
18'0"-19'0"	Brown silt, pockets med. silty sand.	Imp.		35
19'0"-20'6"	Brown fine sandy silt with lime specks.	Imp.	*	65

AUGUSTA SALT WORKS.

BORE NO. 7.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-1'0"	Cream silt.			1
1'0"-3'0"	do.			5
3'0"-7'0"	Grey fine shelly sand, appreciable rootlets.			?
7'0"-9'0"	do.			?
9'0"-10'0"	do.			?
10'0"-11'0"	do.			?
11'0"-12'0"	do.			?
12'0"-13'0"	12'-12'6" do. less shell (10%) 12'6"-13'0" Grey fine clean sand.			?
13'0"-14'0"	Yellow med, clean sand.			?
14'0"-15'0"	Fine light grey sand, trace of shell fragments.			
15'0"-16'0" 16'0"-17'0" 17'0"-18'0" 18'0"-19'0" 19'0"-22'0"	Yellow fine sand grading to medium, then to fine, becoming brown.			
22'0"-25'6"	Brown fine sand grading to brown fine silty sand.			
25'6"-26'6"	Brown very fine sandy silt.	Imp.		
26'6"-28'0"	Rich brown very fine sandy silt.	Imp.	+	?
28'0"-29'6"	do.	Imp.	+	55

BORE NO. 8.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-1'0"	Cream silt.			10
1'0"-2'0"	Creamy grey silt.			3
2'0"-4'0"	do. , becoming shelly at bottom.			6
4'0"-6'0"	4'0"-5'0" Grey very shelly very fine sandy silt. 5'0"-6'0" Grey very shelly silt.			15
6'0"-7'0"	Grey very shelly silt.			
7'0"-9'0"	Dark grey very organic fine sandy silt with appreciable shell fragments and fine shell.			
9'0"-10'0"	do.			
10'0"-11'0"	Dark grey very organic fine sand with shell.			
11'0"-12'0"	do.			
12'0"-13'0"	Light grey fine sand with shell.			
13'0"-14'0"	Light grey grading to brown very fine sandy silt.			
14'0"-15'6"	Light red-brown silt with lime fragments.	Imp.	+	50
15'6"-17'0"	Light brown silt.	Imp.	+	60
17'0"-18'0"	Light brown very fine silty sand with shell and small lime inc.	Imp.		25
18'0"-19'0"	Light brown grading to fine sandy silt.	Imp.		30
19'0"-20'6"			+	

AUGUSTA SALT WORKS.

BORE NO. 9.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-2'0"	Cream silt - very soft.			3
2'0"-14'0"	Sand - shell.			
14'0"-16'0"	Yellow-grey very fine silty sand grading to fine sand.			50
16'0"-17'0"	Yellow-brown med. sand grading to silty sand.			45
17'0"-18'6"	Red-brown very fine sandy silt	Low	+	85
18'6"-20'0"	do. very fine sandy silt with some lime.	"	+	85
20'0"-21'0"	Red very fine silty sand.	"		55
21'0"-22'0"	Red silty sand, somewhat finer.	"		65
	22'0"-23'6"		+	
22'0"-26'0"	Cream very fine sandy silt - calcareous.	Imp.		?
2'0"-4'0"	Cream very fine sandy silt - calcareous, grading to grey shelly sand at bottom.			5
4'0"-6'0"	Grey sand - shell.			5
6'0"-8'0"	Grey very fine sand, some shell, some silt at bottom.			15
8'0"-10'0"	Grey-yellow very fine sand.			25
10'0"-12'0"	do.			25
12'0"-14'0"	do.			30

BORE NO. 10.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-2'0"	Creamy yellow-grey silt.			5
2'0"-4'0"	Grey organic silt - very fibrous.			5
4'0"-6'0"	Grey sand and shell, grading to light grey silty sand, some lime grit.			4
6'0"-8'0"	Light grey silty sand and shells.			8
8'0"-10'0"	Light grey calc. silty sand and small shells.			5
10'0"-12'0"	do.			8
12'0"-14'0"	Light grey calc. silty sand - reducing shell.			20
14'0"-15'0"	Grey-brown fine silty sand, shelly, grading to yellowy fine sandy silt.	Rel. Imp.		30
15'0"-16'6"	Yellow very fine sandy silt.	"	+	45
16'6"-17'6"	Yellow very fine sandy silt inc. lime with depth.	Low		25
17'6"-18'6"	do.	"		50
18'6"-19'6"	Yellow very fine sandy silt - increase in lime.	"		80
19'6"-21'0"	Red-brown calcareous very fine sandy silt.	Imp.	+	130
21'0"-22'6"	do.		+	120

AUGUSTA SALT WORKS.

BORE NO. 11.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-10'0"	Box - see below.			
21'0"-23'0"	Med. red sand - some shell.			25
23'0"-24'0"	do. - no shell.			45
24'0"-25'0"	do.			60
25'0"-26'0"	do. - slightly finer.			65
26'0"-27'0"	do.			50
27'0"-28'0"	do.			40
28'0"-29'0"	do.			45
29'0"-30'0"	do.			65
30'0"-31'0"	do.			60
31'0"-32'0"	do.			65
32'0"-33'0"	do.			45
33'0"-34'0"	Med. red sand, becoming slightly silty.			55
34'0"-35'0"	Red fine silty sand.			55
35'0"-36'0"	Red slightly silty sand, becoming calcareous.			65
36'0"-37'0"	Light grey and cream calcareous silty sand.			70
37'0"-38'0"	Light grey calc. fine silty sand.	Low		60
38'0"-39'6"	Light grey and brown patchy, very calc. fine silty sand.	Low		115
39'6"-41'0"	Buff very fine calc. sand		+	160
41'0"-42'0"	Pinkish cream and grey patchy very fine silty sand, and sandy silt.			95
42'0"-42'6"	Pinkish cream and grey patchy very fine silty sand and sandy silt, very firm - increase red colour.	Rel. Imp.		100
42'6"-43'0"	do.	"		60
43'0"-44'6"	Pinkish cream and grey patchy very fine silty sand and sandy silt, very firm - more red.	"	+	175
10'0"-12'0"	L. grey shelly sand.	P.		15
12'0"-14'0"	L. grey fine sand grading to pink-grey.	P.		20
14'0"-15'0"	Grey fine sand.	P.		50
15'0"-17'0"	(15'0"-16'0" Grey fine sand. (16'0"-17'0" Light brown fine sandy silt.	P. Imp.		50
17'0"-18'6"	L. brown and grey variable fine sand and fine silty sand.	Rel. Imp.		60
18'6"-19'0"	(17'6"-19'0" Blow back 1'0"). Brown fine sand.	P.		30
19'0"-20'0"	Brown fine sand.	P.		40
20'0"-21'0"	Brown fine sand, some small shell.	P.		45

AUGUSTA SALT WORKS.

BORE NO. 11A..

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-10'0"	No sample - sands and shell.			
10'0"-12'0"	Grey calc. shelly silt - soft.	Rel.Imp.		
12'0"-14'0"	do. small shells.	Imp.		
14'0"-16'0"	do. grading to reddy brown silt, small shells.	Imp.		
16'0"-18'6"	Grey calc. silt - soft grading to yellow	Imp.		
	Silty fine sand.	Rel.Imp.		
18'6"-20'0"	Light brown silty sand grading to sand.	P.	+	
20'0"-22'0"	Brown sand			
22'0"-24'0"	Brown fine sand			
24'0"-26'0"	Brown sand			
26'0"-28'0"	Brown sand becoming silty at 27'6"			
28'0"-31'0"	Brown fine silty sand			
31'0"-32'6"	Brown fine sandy silt grading to very fine sandy silt.	Imp.		
32'6"-34'0"	Brown fine to very fine silty sand.	Mod. Perm.		
34'-0"-36'0"	Brown fine to very fine silty sand.	"		
36'0"-37'6"	Brown fine slightly silty sand - calcareous.	"		
37'6"-39'0"	Brown and grey medium to fine slightly silty sand.	"		
39'0"-40'0"	Brown and cream very fine sandy calc. silt.	Low Perm.		
40'0"-42'6"	Brown and cream very fine silty sand calc.	L.P.		
	40'0"-41'6"		+	

BORE NO. 12. + 200E.

0'-10'0"	Sands and shell	P.		
10'0"-12'0"	Grey shelly silt - open	P.		30
12'0"-14'0"	Grey shelly silt - softer	P.		25
14'0"-15'0"	Brown-yellow grey silty sand	R.P.		15
15'0"-16'0"	Light grey-yellow fine slightly silty sand - shelly	P.		20
16'0"-17'0"	Light grey fine sand			25
17'0"-18'0"	Do.			30
18'0"-19'0"	Do.			30
19'0"-20'0"	Light grey brown clean fine sand.	P.		10
20'0"-21'0"	Do.	P.		25
21'0"-22'0"	Brown grey very fine sand.	P.		35
22'0"-23'0"	Do.	P.		35
23'0"-24'0"	Do.	P.		35
24'0"-25'0"	Do.	P.		45
25'0"-26'0"	Do. becoming silty.	P.		40
26'0"-27'6"	Brown fine sandy silt.	L.P.	+	75
27'6"-29'0"	Do.		+	70
29'0"-30'0"	Brown fine sandy silt with sand layer 6" at 29'3"-29'9"			45
30'0"-31'0"	Brown slightly silty fine sand.			40
31'0"-32'6"	Brown sand.		+	20

AUGUSTA SALT WORKS.

BORE NO. 13.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-10'0"	No sample - sands and shell.	P.		
10'0"-13'0"	Grey shelly silt with many fine rootlets.	P.		
13'0"-15'6"	Grey shelly silt with many fine rootlets, changing at 15'0" to yellow calc. fine sandy silt.	Rel. Imp. Imp.		
15'6"-17'0"	Yellow calc. fine sandy silt.			
17'0"-18'6"	Brown very fine slightly silty sand.	L. to M.P.		
18'6"-20'0"	do.	" " "		
20'0"-21'0"	do.			
21'0"-22'0"	do.			
22'0"-23'6"	Red-brown very fine silty sand.	M.P.		
23'6"-25'0"	Brown very fine sand.	P.		
25'0"-27'0"	Brown very fine sand.	P.		
27'0"-29'0"	do.			
29'0"-30'0"	Brown very fine sand grading to very fine sandy silt.	R.P. Imp.		
30'0"-31'6"	Brown slightly calc. very fine sandy silt.	Imp.		
31'6"-33'0"	do.	Imp.		
33'0"-34'6"			+	

BORE NO. 14.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-10'	No sample - sands, shell.			
10'0"-12'0"	Coarse sand-shell, changing at 10'3" to black organic silt, many rootlets - very soft.	P.		
12'0"-15'0"	Grey sandy shelly silt with pockets of sand - soft.	M.P.		
15'0"-17'0"	do.	M.P.		
17'0"-19'0"	do.	M.P.		
19'0"-21'0"	do.	M.P.		
21'0"-22'0"	Mottled brown sandy silt.	Imp.		
22'0"-23'6"	do.	Imp.		
23'6"-25'0"	Mottled brown sandy silt finishing on fine sand.	Imp.-P.		
25'0"-26'6"			+	

AUGUSTA SALT WORKS.

BORE NO. 15.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-10'0"	No sample - sands, shell.			
10'0"-13'0"	Grey silt and shell - very soft.	Rel. Imp.		
13'0"-15'0"	Grey silt and shell - very soft, grading to mottled yellow-grey.	"		
15'0"-17'0"	Brown, fine calc. slightly silty sand.	M.P.		
17'0"-17'9"	do.	M.P.		
17'9"-19'0"	Brown very fine sand.	P.		
19'0"-20'0"	do.	P.		
20'0"-22'0"	Brown very fine slightly silty sand.	M.P.		
22'0"-24'0"	Brown very fine silty sand.	L.P.		
24'0"-26'0"	do.	L.P.		
26'0"-28'0"	Red-brown and brown silt.	Imp.		
28'0"-35'6"	Brown and reddy-brown silt grading to mottled grey and brown at 32'0" approx. and then becoming slightly more sandy to finish in mottled very fine silty sand.	Imp.		
29'6"-31'0"			+	
35'6"-37'0"			+	

BORE NO. 16.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-10'0"	Sands, shell - no sample.	V.P.		
10'0"-16'0"	Grey-blue grey silt (fine), shelly and with many fine rootlets. Pockets coarse sand.	L.-M.P.		
16'0"-18'0"	Creamy yellow calc. silt.	Imp.		
18'0"-21'0"	do.			
	18'0"-19'6"		+	
	19'6"-21'0"		+	
21'0"-22'0"	Red-brown shelly silt.	Imp.		
22'0"-23'0"	Mottled red-brown yellow-grey sandy silt (firm).	Imp.		
23'0"-24'0"	Grey and buff calc. very fine silty sand (firm).	Imp.		
24'0"-27'0"	do.	Imp.		
27'0"-28'6"			+	

AUGUSTA SALT WORKS.

BORE NO. 17.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-10'0"	No sample.			
10'0"-12'0"	Dark grey silt, small shells and appreciable fine roots, very soft.	P.		
12'0"-14'0"	do.	P.		
14'0"-16'0"	Light grey very calc. very fine sandy silt.	M.L.P.		
16'0"-17'0"	Brown and grey streaked very calc. clayey silt and some shell frag.	Imp.		
17'0"-18'0"	do.	Imp.		
18'0"-19'6"		Imp.	+	
19'6"-21'0"				
21'0"-23'0"	Brown and grey streaked very calc. clayey silt top half, then brown fine silty sand, shelly.	Imp. / M.P.		
23'0"-25'0"	Yellow, light brown and grey patchy very fine silty sand.	L.P.		
25'0"-26'6"			+	

BORE NO. 18.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-10'0"	No sample.			
10'0"-13'0"	Dark grey silt, small shells and abundant very fine roots - very soft.	P.		
13'0"-15'0"	L. grey very calc. silt - shell and root fibre.	M.L.P.		
15'0"-17'0"	Buff and grey mottled very calc. silt, abundant shell (small).	Imp.		
17'0"-18'6"	Buff and grey grading to greenish grey very calc. silt, grading to fine silty sand, small shell - firm.	Imp.		
18'6"-20'0"	Buff very calc. silt - some small shell - firm.	Imp.		
20'0"-21'6"			+	
21'6"-23'0"			+	
23'0"-24'6"	Light grey and yellow very calc. very fine silty sand - firm.	P.L.P.		
24'6"-25'0"	Buff very calc. fine silty sand - very firm.	M.L.P.		
25'0"-26'6"			+	

AUGUSTA SALT WORKS.

BORE NO. 19.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-10'0"	No samples.			
10'0"-13'0"	Dark grey silt, small shells and abundant very fine roots - very soft.	P.		
13'0"-15'0"	L. grey very calc. silt - shell and root fibre.	M.L.P.		
15'0"-17'0"	L. grey very calc. silt, becoming finer - into buff and L. brown very calc. clayey silt.	L.P.-Imp.		
17'0"-18'0"	~~L. grey very calc. silt, becoming finer - into~~ buff and L. brown very calc. clayey silt.	Imp.		
18'0"-19'6"			+	
19'6"-21'0"			+	
21'0"-23'0"	do.	Imp.		
23'0"-24'6"			+	

BORE NO. 20.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-10'0"	No sample.			
10'0"-12'0"	L. grey very calc. silt, shelly - soft.	M.L.P.		20
12'0"-13'0"	L. grey very calc. silt - less shell - some small kunkar, soft.	M.L.P.		15
13'0"-14'0"	L. grey very calc., very fine sandy silt - soft.	M.L.P.		15
14'0"-15'0"	Buff to L. grey very calc., very fine sandy silt - soft.	L.P.		20
15'0"-16'0"	Biscuit-buff, mottling, very calc. fine sandy silt - very firm.	M.P.		35
16'0"-17'6"	R. brown and grey mottled fine sandy silt - firm.	R.L.P.	*	40
17'6"-19'0"	L. brown fine sandy silt - structured.	L.P.	+	120
19'0"-20'0"	Brown and grey mottled sandy silt - structured.	Imp.		80
20'0"-21'0"	Brown and grey mottled sandy silt - structured - very calc.	"		120
21'0"-22'6"	do.	"	+	115

BORE NO. 21.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-10'0"	No sample.			
10'0"-12'0"	L. grey very calc. sandy silt with rounded lime nodules.	P.		20
12'0"-13'0"	L. grey very calc. sandy silt.	M.P.		20
13'0"-14'0"	do.	L.P.		40
14'0"-15'0"	L. grey very calc. silty fine sand.	Rel.Imp.		90
15'0"-16'6"	do.	"	*	75
16'6"-18'0"	do.	"	+	80
18'0"-19'0"	Buff-grey mottled marl.	M.P.		80
19'0"-20'0"	Brown-grey very calc. lightly cemented sandy silt.	Imp.		250
20'0"-21'0"	do.	"	*	320

AUGUSTA SALT WORKS.

BORE NO. 22.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-2'0"	Buff silt, some shell - very soft.			3
2'0"-5'0"	Buff silt becoming sandy, then sand-shell mixture at approx. 3'6"	P.		6
5'0"-8'0"	Grey silt and shell - very soft.	M.P.		5
8'0"-9'0"	do. do.	M.P.		
9'0"-10'0"	Grey fine sand with some shell.	P.		
10'0"-11'0"	Grey fine sand - very few shells.	P.		
11'0"-12'0"	Grey fine sand.	P.		10
12'0"-13'0"	Grey fine to very fine sand.	P.		10
13'0"-14'0"	Grey fine silty sand.	M.P.		12
14'0"-15'0"	do.	M.P.		13
15'0"-17'0"	do.	M.P.		35
17'0"-18'6"	Brown and cream calc. very fine sandy silt.	Imp.	+	65
18'6"-20'0"	do.	Imp.	+	100
20'0"-21'0"	do.	Imp.		50
21'0"-22'0"	Brown slightly calc. silt.	Imp.		35
22'0"-23'6"	Brown silt.	Imp.	+	120

BORE NO. 23.

0'-2'0"	Buff, very soft silt.			2
2'0"-4'0"	2'0"-3'0" Buff, very soft silt.			7
	3'0"-4'0" Brown sand and shell and pockets of organic silt.	P.		
4'0"-6'0"	Grey fine sand and shells.	P		4
6'0"-8'0"	Blue-grey very fine sand.	P.		25
8'0"-9'0"	do.	P.		25
9'0"-10'0"	do.	P.		20
10'0"-12'0"	Grey medium sand.	P.		
12'0"-13'0"	Brown medium sand.	P.		20
13'0"-14'0"	Brown very fine sand.	P.		60
14'0"-15'0"	do.	P.		65
15'0"-16'0"	Brown very fine sand changing to slightly calc. very fine sandy silt at 15'3".	Imp.		68
16'0"-17'6"	Brown calc. very fine sandy silt.	Imp.	+	65
17'6"-19'0"	do.	Imp.	+	85
18'0"-20'0"	do.			45
20'0"-21'0"	Brown calc. very fine sandy silt, pockets lime.			65
21'0"-22'0"	Brown fine sandy silt.			85
22'0"-23'6"	do.		+	85

AUGUSTA SALT WORKS.

BORE NO. 24.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-2'0"	Cream silt, many roots - very soft.			1
2'0"-4'0"	Grey silty sand - very shelly.			3
4'0"-6'0"	Grey silty sand - smaller shell.	P.		3
6'0"-7'0"	Grey very fine sand - some shell.	P.		30
7'0"-8'0"	do.	P.		25
8'0"-10'0"	do.	P.		40
10'0"-12'0"	Gray very fine sand - no shell.	P.		45
12'0"-14'0"	Grey very fine sand, becoming coarser and yellow.	P.		30
14'0"-16'0"	Yellow-brown very fine sand, becoming silty.	M.P.		50
16'0"-17'0"	Brown very fine silty sand to very fine sandy silt, calc.	Imp.		35
17'0"-18'6"	L. brown, very fine sandy silt - calc.	Imp.	+	75
18'6"-20'0"	do.	Imp.	+	85
20'0"-21'0"	L. brown, very fine sandy silt, calc., with pockets of fine sand.	Imp.		20
21'0"-22'0"	do.	Imp.		25
22'0"-23'6"	L. brown very calc. silt.		+	70

BORE NO. 25.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-2'0"	Cream very soft silt, shelly, grading to yellow medium sand, shelly.			10
2'0"-4'0"	L. yellow medium sand with apprec. shell.	P.		1
4'0"-6'0"	L. yellow medium sand with apprec. shell top foot, then grey organic silt, sand-shell.	P.		3
6'0"-8'0"	Grey fine sand organic remains - many rootlets and small shell.	P.		6
8'0"-10'0"	do.	P.		6
10'0"-12'0"	Grey very fine sand with fine rootlets.	P.		25
12'0"-14'0"	do.	P.		45
14'0"-16'0"	do.	P.		80
16'0"-17'0"	do.	P.		60
17'0"-18'0"	Grey fine sand changing to brown calc. med. sand at 17'8"	P.		60
18'0"-19'0"	Brown slightly silty med. sand.	P.		40
19'0"-20'0"	Mottled browns and greys slightly silty med. to coarse sand.	P.		20
20'0"-21'0"	L. brown silty sand to sandy silt with pockets of sand.	L.P.		25
21'0"-22'0"	Brown calc. very fine sandy silt.	Imp.		30
22'0"-23'0"	Brown slightly calc. silt.	Imp.		60
23'0"-24'6"	Brown silt - some mottled.	Imp.	+	45
24'6"-26'0"	do.	Imp.	+	65
26'0"-27'0"	Brown silt with pockets sand and some lime grit, becoming sandy and calc. at bottom.	Imp.		20
27'0"-28'0"	Brown very fine sandy silt and silt in pockets.	Imp.		35
28'0"-29'6"	Brown calc. silt with very calc. patches.	Imp.	+	110

AUGUSTA SALT WORKS.

BORE NO. 26.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-10'0"	Samples not received.			
10'0"-12'0"	L. green-grey fine sandy silt.	Low		30
12'0"-13'0"	do.	"		30
13'0"-14'0"	do.	"		20
14'0"-15'0"	L. green-grey fine sandy silt, becoming coarser.	"		20
15'0"-16'0"	Grey very fine silty sand.	M.P.		15
16'0"-17'0"	Grey very fine silty sand, changing to calc. brown silt at about 16'6".	P. Imp.		20
17'0"-18'6"	Brown calc. silt.	Imp.	+	70
18'6"-20'0"	~~No sample.~~ (Prob. as above and below).		+	60
20'0"-21'0"	Brown and grey mottled calc. silt.	Imp.		60
21'0"-22'0"	Brown with blue-grey mottling calc. silt.	Imp.		60
22'0"-23'6"	do.	Imp.	+	65

BORE NO. 27.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-10'0"	No sample.			
10'0"-12'0"	Blue-grey very fine silty sand.	Rel.Imp.		
12'0"-14'0"	Blue-grey very fine sandy silt.	Imp.		
14'0"-15'0"	Blue-grey very fine sandy silt, changing to brown very fine sandy silt.	Imp.		
15'0"-16'0"	Brown very fine sandy silt with pockets fine sand.	Imp.		
	16'0"-17'6"		+	
16'0"-20'0"	Brown mottled grey-blue silt.	Imp.		
	17'6"-19'0"		+	
20'0"-21'0"	Brown mottled grey-blue silt.	Imp.		
21'0"-23'0"	Brown mottled grey-blue silt grading to very fine silty sand.	Imp.		
23'0"-24'6"			+	

BORE NO. 28.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-8'0"	No sample.			
8'0"-9'0"	Blue-grey calc. silt.	Imp.		50
9'0"-10'0"	Blue-grey calc. silt changing to greenish very calc. silt.	Imp.		45
10'0"-11'6"	Brown with cream mottled calc. silt.	Imp.	+	55
11'6"-13'0"	Brown calc. fine silty sand.	L.P.	+	70
13'0"-14'0"	Brown-grey silt - calc.	Imp.		45
14'0"-15'0"	Blue-grey calc. (slightly) silt, grading to brown mottled silt.	Imp.		50
15'0"-16'6"	Red-brown calc. silt.	Imp.		60

AUGUSTA SALT WORKS.

BORE NO. 29.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-10'0"	No sample.			
10'0"-12'0"	Var. grey very calc. silt changing to cream very calc., very fine sandy silt with shells.	L.P.		30
12'0"-13'0"	Grey-green very calc. very fine sandy silt.	Imp.		30
13'0"-14'0"	Green-grey and yellow very calc. silt, becoming brown.	Imp.		40
14'0"-15'6"	Brown very fine sandy silt (calcareous).	Imp.	+	55
15'6"-17'0"	Red calcareous very fine sandy silt.	Imp.		60
17'0"-18'0"	Mottled reds and greys very calc. silt - soft.	L.P.		45
18'0"-19'0"	Mottled reds and greys very calc. silt - firmer.	L.P.		55
19'0"-20'6"	do.		+	85

BORE NO. 30.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-10'0"	No sample.			
10'0"-12'0"	L. grey very calc. silt and shells, becoming yellow at bottom.	L.P.		40
12'0"-13'0"	Yellow and grey mottled very calc. silt and shell - soft.	L.P.		20
13'0"-15'0"	Yellows - very fine sandy silt, very calc.	L.P.		40
15'0"-16'0"	Yellows - very fine sandy silt, very calc., plus some shell.	"		40
16'0"-17'0"	Yellows - very fine sandy silt, very calc. - no shell.	"		40
17'0"-18'0"	Yellows - very fine sandy silt. very calc. - with shell.	"		50
18'0"-19'0"	Yellows - very fine very calc. silty sand.	"		60
19'0"-20'6"	Red-brown very fine very calc. sandy silt.	Imp.	+	85
20'6"-22'0"	do.		+	75
22'0"-23'0"	Yellow-brown med. to fine sand with shell.	P.		30
23'0"-24'0"	Yellow-brown med. to fine sand with shell, calc.	P.		45
24'0"-25'6"	L. brown very calc. very fine sandy silt with lime.cemented nodules.	M.P.	+	140

AUGUSTA SALT WORKS.

BORE NO. 31.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-10'0"	No sample.			
10'0"-11'0"	Green-grey very calc. silt, shelly - soft.	Imp.		15
11'0"-13'0"	do.	"		25
13'0"-14'0"	do.	"		8
14'0"-15'0"	do.	"		20
15'0"-16'0"	Buff and browns, very calc. fine sandy silt.	L.P.		25
16'0"-17'0"	do.	"		30
17'0"-18'0"	Brown and grey, mottling, very calc. silt.	"		80
18'0"-19'6"	Red very calc., very fine sandy silt.	L.P.	+	60
19'6"-21'0"	Red very calc., very fine sand with lime cemented nod.	"	+	75
21'0"-22'0"	Red very calc., very fine silty sand with lime cemented nodules.	"		65
22'0"-23'0"	Brown calc. fine silty sand.	"		75
23'0"-24'6"	Brown and whitish patchy very calc., very fine silty sand.	"	+	160

BORE NO. 32.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-10'	No sample.			
10'0"-12'0"	Light grey very calc. very fine sandy silt - appreciable shell and abundant fine roots - soft.	L.P.		20
12'0"-13'0"	Light grey very calc. very fine sandy silt - appreciable shell, less roots - soft.	L.P.		15
13'0"-14'0"	do.	"		20
14'0"-15'0"	Light grey very calc. fine silty sand - appreciable shell, firm.	Rel.Imp.		40
15'0"-16'0"	Buff, very calc. <u>very</u> fine sandy silt.	L.P.		50
16'0"-17'0"	Buff, very calc. fine sandy silt with small limestone nodules.	L.P.		60
17'0"-18'6"	Light brown and cream very calc. very fine sandy silt.	M.P.	+	70
18'6"-20'0"	Light brown and cream, but more calc. very fine sandy silt, patches of glauconite.	M.P.	+	130
20'0"-21'0"	do.	L.P.		60
21'0"-22'0"	do.	L.P.		100
22'0"-23'6"	do.	L.P.	+	85

AUGUSTA SALT WORKS.

BORE NO. 33.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-10'0"	No sample.			
10'0"-11'0"	Light grey very calc., very fine sandy silt with abundant fine roots and small shell fragments.	P.		20
11'0"-13'0"	do.	P.		25
13'0"-14'0"	do.	P.		20
14'0"-15'0"	Blue-grey very calc. finer sandy silt with abundant fine roots and small shell fragments.	M.P.		35
15'0"-16'0"	Blue-grey very calc. finer sandy silt with abundant fine roots and small shell fragments - firmer.	M.P.		55
16'0"-17'6"	Light brown very calc. fine sandy silt.	Imp.	+	75
17'6"-19'0"	do.		+	125
19'0"-21'0"				
21'0"-22'0"			+	

BORE NO. 34.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-9'0"	No sample.			
9'0"-10'0"	Red-brown mottled grey calc. very fine sandy silt.	Imp.		
10'0"-11'6"			+	
11'6"-13'0"			+	
13'0"-14'0"	Brown calc. silt. Very firm.	Imp.		
14'0"-15'0"	do. do.	Imp.		
15'0"-17'0"	Brown sand top half, then firm brown silt.	P. Imp.		

Very poor box..

AUGUSTA SALT WORKS.

BORE NO. 35.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-10'0"	No sample received.			
10'0"-12'0"	Very fine sand.			6
12'0"-14'0"	Light brown fine sand, becoming silty at 14'0".	F.P. L.P.		30
14'0"-16'0"	Grey-brown calc. silt.	Imp.		20
16'0"-18'0"	Grey-brown calc. silt grading to fine sandy silt.	Imp.		30
18'0"-19'0"	Mottled brown grey-blue silt.	Imp.		20
19'0"-20'0"	Light brown calc. fine sandy silt.	Imp.		25
20'0"-21'0"	Yellow-brown calc. fine silty sand.	L.P.		30
21'0"-22'0"	Light brown calc. very fine silty sand.	M.P.		25
22'0"-23'0"	do.	M.P.		30
23'0"-24'0"	Brown and grey calc. med. sand to mottled silt, very calc.	M.P. L.P.		25
24'0"-25'0"	Mottled brown green-grey silt, changing to varicol fine sand.	L.P. M.P.		45
25'0"-26'0"	Brown and greeny-grey patchy sand and silt.	M.P.		50
26'0"-27'0"	do.	L.P.		60
27'0"-28'0"	Brown fine sand.	M.P.		70
28'0"-29'0"	Brown and grey mottled very fine sand.	M.P.		75
29'0"-30'0"	do.	M.P.		65
30'0"-31'0"	do.	M.P.		70

BORE NO. 36.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-10'0"	No sample.			
10'0"-12'0"	Yellow med. sand with shell.	P.		
12'0"-14'0"	Grey med. sand with fine shell fragments.	P.		
14'0"-15'0"	do.	P.		
15'0"-16'0"	do.			
16'0"-17'0"	Blue-grey very calc. very fine sandy silt with pockets of very fine sand - shell fragments.	L.P.		
17'0"-18'6"			+	
18'6"-20'0"			+	
20'0"-21'0"	Brown very fine sandy silt, very calc.	Imp.		
21'0"-23'0"	Brown silt, calcareous.	Imp.		
23'0"-25'0"	Light brown very calc. silt.	Imp.		
25'0"-26'6"			+	

AUGUSTA SALT WORKS.

BORE NO. 37.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-10'	No sample.			
10'0"-12'0"	Grey med. to fine shelly sand.	P.		
12'0"-14'0"	To 13'9" Grey med. to fine shelly sand, then brown calc. silt.	P.) Imp.)		
14'0"-15'0"	Brown-grey mottled calc. silt.	Imp.		
15'0"-16'6"			+	
16'6"-18'0"	~~No samples.~~		+	
18'0"-19'6"	Brown very calcareous silt.	Imp.		
19'6"-21'0"	do.	Imp.		
21'0"-22'0"	do.	Imp.		
22'0"-23'6"	Choc. brown very calc. silt.	Imp.		
23'6"-25'0"			+	

BORE NO. 38.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-10'0"	No sample.			
10'0"-12'0"	Grey very calc. very fine sand.	P.		
12'0"-14'0"	do.	P.		
14'0"-16'0"	Grey very calc. very fine sand, changing to brown very calc. silt at about 15'0".	P. Imp.		
16'0"-17'6"			+	
17'6"-19'0"			+	
19'0"-20'0"	Brown and grey mottled very calc. very fine sandy silt.	Imp.		
20'0"-21'6"	Yellow very calcareous silt.	Imp.		
21'6"-23'6"	Yellow very calcareous silt, becoming sandy with depth.	Imp.		
23'6"-24'6"	Yellow and grey very fine sand.	M.P.		
24'6"-26'0"			+	

AUGUSTA SALT WORKS.

BORE NO. 39.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-1'6"	Cream silt, very soft.			
1'6"-3'0"	Brown and grey very soft silt.			
3'0"-4'0"	Brown and grey silt, firmer, becoming sandy.			
4'0"-5'0"	Brown and grey fine shelly sand.	P.		
5'0"-6'0"	Brown and grey medium to fine shelly sand.	P.		
6'0"-7'0"	Grey fine sand.	P.		
7'0"-8'0"	do.	P.		
8'0"-9'0"	do.	P.		
9'0"-10'0"	Grey very fine sandy silt.	Rel.Imp.		
10'0"-11'0"	Grey very fine sandy silt - soft.	" "		
11'0"-12'0"	do. do.	" "		
12'0"-13'0"	do. do.	" "		
13'0"-14'0"	Grey mottled yellow very fine sandy silt - firm.	Imp.		
14'0"-15'0"	do.	"		
15'0"-16'0"	Grey and brown, mottling, very fine sandy silt.	"		
16'0"-17'0"	Yellow very calc. silt - firm.	"		
17'0"-18'6"			+	
18'6"-20'0"	~~No sample.~~		+	
20'0"-24'0"	Yellow-grey calcareous silt.	"		
24'0"-26'6"	Yellow-grey calc. very fine sandy silt - firm.	"		
26'6"-28'0"	Yellow fine sand - slightly calc.	P.		
28'0"-29'0"	Grey fine sand.	P.		
29'0"-30'0"	Green-grey fine sand.	P.		
30'0"-31'0"	Green-grey fine sand grading to brown med. fine sand.	P.		
31'0"-34'0"	Brown-grey sand.	P.		
34'0"-36'6"	Brown fine to med. sand.	P.		
36'6"-38'6"	Brown silt - very firm.	Imp.		
38'6"-40'0"	Brown silt - calcareous - very firm	Imp.	+	

BORE NO. 40.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-10'0"	No sample			
10'0"-11'0"	Grey very calcareous silt with shell - soft.	Imp.		
11'0"-12'0"	Grey very calcareous silt with fine roots little shell - soft.	Imp.		
12'0"-13'0"	do.	"		
13'0"-14'0"	Grey very calcareous silt with lime nodules.			
14'0"-15'6"	~~No samples.~~		+	
15'6"-17'0"			+	
17'0"-18'0"	Brown very fine sandy silt - very calc. Firm.	"		
18'0"-19'0"	Brown silt, calc. Firm.	"		
19'0"-21'0"	Brown fine sandy silt. Firm.	L.P.		
21'0"-22'6"	do.	"		
22'6"-24'0"			+	

AUGUSTA SALT WORKS.

BORE NO. 41.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-10'0"	No samples.			
10'0"-12'0"	Brown sandy silt - calc. Firm.	L.P.		
12'0"-13'6"			+	
13'6"-15'0"	~~No sample.~~		+	
15'0"-16'0"	Brown sandy silt - very calc. Very firm.	Imp.		
16'0"-17'0"	Brown very calc. silt with some very fine sand. Very firm.	Imp.		
17'0"-18'0"	do.	"		
18'0"-20'0"	Brown very calc. silt - ~~no sand~~ - mottled. Very calc. Very firm.	"		
20'0"-21'6"			+	

BORE NO. 42.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-10'0"	No sample.			
10'0"-13'0"	Dark grey silt with small shells - abundant fine roots - soft.	P.		
13'0"-16'0"	Yellow and grey very calc. very fine sandy silt - small nodules of limestone.	R.P.		
16'0"-18'0"	Yellows and greys very calc., very fine sandy silt - soft, with limestone nodules.	Imp.		
18'0"-21'0"	Red, brown and grey patchy silt.	"		
	18'0"-19'6"		+	
	19'6"-21'0"		+	
21'0"-23'0"	Brown and grey very calc., very fine sandy silt.	Imp.		
23'0"-24'6"			+	

BORE NO. 43.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-10'0"	No sample.			
10'0"-12'0"	Brown calc. silty sand - very calc.	M.P.		
12'0"-14'0"	Brown calc. silty sand, very calc., becoming finer.	Rel. Low Perm.		
14'0"-15'6"			+	
15'6"-17'0"			+	
17'0"-18'0"	Brown calc. silty very fine sand, very calc.	L.P.		
18'0"-20'0"	Brown very fine sandy silt - very calc.	Imp.		
20'0"-22'0"	do.	"		
22'0"-24'0"	do.	"		
24'0"-25'6"			+	

AUGUSTA SALT WORKS.

BORE NO. 44.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-8'0"	No sample.			
8'0"-9'0"	Brown very fine sandy silt - very calc. Firm.	L.P.		
9'0"-11'0"	Browns and creams very fine silty sand - very calc. Firm.	"		
11'0"-12'6"			+	
12'6"-13'6"	Browns and creams very fine sandy silt - very calc. Firm.	"		
13'6"-14'0"	Brown silt - slightly calc. Very firm.	Imp.		
14'0"-15'0"	Brown silt, ~~slightly~~ calc. - ~~increased lime.~~ Very firm.	"		
15'0"-16'0"	Red-brown slightly calc. silt with lime nodules. Very firm.	"		
16'0"-17'0"	do. do.	"		
17'0"-18'6"	do. do.	"		
18'6"-20'0"			+	

BORE NO. 45.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
2'0"-3'6"	Red very calc. very fine sandy silt. Very firm.	"		
3'6"-5'0"	do.	"		
5'0"-6'0"	Brown very calc. very fine sandy silt. Very firm.	"		
6'0"-7'0"	do.	"		
7'0"-8'6"			+	
8'6"-10'0"			+	
10'0"-11'6"	Brown very calc. very fine sandy silt. Very firm.	"		
11'6"-13'0"	do.	"		
13'0"-15'0"	Brown mottled very calc. very fine sandy silt. Very firm.	"		
15'0"-17'0"	do.	"		
17'0"-18'6"	Brown calc. very fine silty sand. Mod. firm.	L.P.		
18'6"-20'0"			+	

BORE NO. 46.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-3'0"	Creamy grey silt - very soft.			
3'0"-4'6"	Red-brown mottled cream-grey calc. silt.	Rel.Imp.		
4'6"-5'6"	Brown silt.	Imp.		
5'6"-7'0"	do.			
7'0"-8'6"	Brown <u>very</u> fine sandy silt, very calc., patches lime.	"	*	
8'6"-10'0"	do.	"	*	
10'0"-11'6"	R. brown silt.	"		
11'6"-12'6"	Brown mottled green-grey calc. silt.	"		
12'6"-14'0"	Red-brown silt - slightly calc.	"		
14'0"-15'0"	Red silt - slightly calc.	"		
15'0"-16'0"	Red fine sandy silt - calcareous.	"		
16'0"-17'6"	Red-brown and brown calc. fine sandy silt.	"	*	

AUGUSTA SALT WORKS.

BORE NO. 47.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-4'0"	White mottled browns-blues, shelly, very calcareous silt, very soft.			
4'0"-5'6"	Grey very calcareous very shelly silt - very soft.			
5'6"-7'0"	Buff silty marl with limestone nodules - soft.			
7'0"-8'6"	Buff silty marl with limestone nodules - firmer.	Med.perm.		
8'6"-10'0"	do.			
10'0"-11'6"	do.		*	
11'6"-13'0"	Red, very fine sandy silt - slightly calc.	L. perm.	*	
13'0"-14'0"	do.	L. perm.		
14'0"-16'0"	Red, very fine sandy silt changing to brown and inc. lime.	Imp.		
16'0"-18'0"	Brown very fine sandy silt, patchy lime, rich areas.	Imp.		
18'0"-19'6"	do.	"	*	

BORE NO. 48 + 40' south.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-8'0"	No sample.			
8'0"-9'0"	L. grey very calc. silt - soft.	M.L.P.		35
9'0"-10'0"	L. grey very calc. silt - firm.	L.P.		115
10'0"-11'6"	Brown silt, calc. patches.	Imp.	*	60
11'6"-13'0"	L. brown calc. silt.	"	*	55
13'0"-14'0"	do.	"		35
14'0"-15'0"	Brown silt, calc. patches.	"		65
15'0"-16'6"	do.	"	*	160

AUGUSTA SALT WORKS.

BORE NO. 49.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-10'0"	No sample.			
10'0"-11'6"	Light grey very shell med. sand.	P.		
11'6"-13'0"	Light grey very shelly med. sand, changing at about 12'6" to brown silt - calc. Firm.	P. Imp.		
13'0"-15'0"	Brown calc. very fine sandy silt - very calc. Firm.	"		
15'0"-16'6"			+	
16'6"-18'0"	~~No sample.~~		+	
18'0"-19'0"	Brown silt - calc. Firm.	Imp.		
19'0"-20'6"	Brown silt - calc. - some lime nodules. Firm.	"		
20'6"-22'0"			+	

BORE NO. 50.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-10'0"	No sample.			
10'0"-11'0"	Browns - very fine sandy silt with pockets grey fine sand. Soft.	L.P.		
11'0"-13'0"	Brown med. sand to brown calc. very fine sandy silt. Soft.	"		
13'0"-14'6"			+	
14'6"-16'0"			+	
16'0"-17'0"	Brown very calc. silt. Firm.	Imp.		
17'0"-18'0"	Brown very calc. silt. - less lime. Firm.	"		
18'0"-19'0"	Brown very calc. silt, less lime - becoming sandy. Firm.	"		
19'0"-22'6"			+	

AUGUSTA SALT WORKS.

BORE NO. 51.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-10'0"	No sample.			
10'0"-12'0"	Dark grey very calc. shelly silt, abundant fibrous roots, pockets fine sand.	P.		
12'0"-14'0"	Dark grey very calc. shelly silt, few roots, pockets fine sand.	P.		
14'0"-16'0"	L. grey very calc. very fine sandy silt, lime nodules.	L.P.		
16'0"-18'0"	L. grey very calc. silt, lime nodules.	L.P.		
18'0"-19'6"	do.	L.P.	+	65
19'6"-21'0"	L. grey to buff very calc. silt.	L.P.	+	85
21'0"-22'0"	L. grey to buff very calc. silt with lime accretions.	L.P.		
22'0"-23'0"	Buff & grey mottling very calc. very fine sandy silt.	Imp.		
23'0"-24'0"	do.	Imp.		
24'0"-25'6"	Kunkar.		+	120

BORE NO. 52.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-10'0"	No sample.			
10'0"-12'0"	Grey very shelly sand.	P.		
12'0"-15'0"	Grey very calc. silt, firm as examined, probably soft in situ.	L.P.		
15'0"-16'6"	Brown & grey mottled very calc. fine sandy silt.	Imp.		
16'6"-18'0"	do.	"	+	58
18'0"-19'6"	do.	"	+	78
19'6"-21'0"	Brown & grey mottled very calc. sandy silt - much finer.	"		
21'0"-22'0"	do.	"		
22'0"-23'0"	Buff & light grey very calc. silt - lime nodules.	"		
23'0"-24'6"	do.	"	+	85

AUGUSTA SALT WORKS.

BORE NO. 53.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-10'0"	No sample.			
10'0"-13'0"	Grey very shelly calc. silt with abundant fibrous roots - very soft.	P.		
13'0"-16'0"	do.			
16'0"-19'0"	L. grey very calc. silt - soft.	M.L.P.		
19'0"-20'6"	do.	"	+	
20'6"-22'0"	Green-grey mottling very calc. silt - firm.	Imp.	+	
22'0"-24'0"	Green-grey mottling very calc. silt - shelly.	"		
24'0"-25'6"	Brown-grey mottled silt - very firm.	"	+	

BORE NO. 54.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-2'0"	Vari-coloured very soft silt, abundant organic matter and roots.	P.		
2'0"-4'0"	Dark grey very soft silt, abundant organic matter and roots - very soft.	P.		
4'0"-7'0"	Grey calc. silt, shelly, organic - very soft.	P.		
7'0"-10'0"	Grey calc. silt, shelly, organic, with roots - very soft.	P.		
10'0"-13'0"	do.	"		
13'0"-16'0"	Dark grey calc. silt, shelly, organic, with roots - very soft.	"		
16'0"-18'0"	do.	"		
18'0"-19'0"	L. grey very calc. silt, some shell - very soft.	"		
19'0"-21'0"	L. grey very calc. silt, some mottling near 21'0" - very soft.	"		
21'0"-22'6"	L. grey <u>very</u> calc. silt, some shell - soft.	L.P.		
22'6"-24'0"	Grey-brown-cream mottled calc. silt - firm.	Imp.		
24'0"-25'6"	do.	"	+	
25'6"-27'0"	Grey-brown-cream mottled silt, some very calc. patches - firm.	"	+	
27'0"-28'6"	do.	"		
28'6"-30'0"	Grey-brown-cream mottled calc. silt, finishing in sand	(Imp. (Perm.	+	

AUGUSTA SALT WORKS.

BORE NO. 54A.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-2'0"	Cream very soft silt.	P.		
2'0"-5'0"	Dark brown organic matter with some silt - very soft.	P.		
5'0"-7'0"	Dark brown organic matter with some silt, becoming shelly - very soft.	P.		
7'0"-10'0"	Grey organic silt, shelly - very soft.	P.		
10'0"-12'0"	Grey organic silt, shelly, some sand - very soft.	P.		
12'0"-14'0"	Grey organic silt, shelly, some sand, with fibrous roots - very soft.	V.P.		
14'0"-16'0"	do.	V.P.		
16'0"-17'6"	do.	V.P.		
17'6"-19'0"	L. grey very calc. shelly silt - soft.	Rel. L.P.		
19'0"-20'6"	do.	"	+	
20'6"-22'0"	Buff very calc. shelly silt.	"	+	
22'0"-23'6"	Buff & grey patches calc. silt - firm.	Imp.		
23'6"-25'0"	Buff & grey patches calc. silt, shelly - firm.	Imp.		
25'0"-26'6"			+	

BORE NO. 55.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-3'0"	Brown & cream fine sandy silt - soft.	M.P.		
3'0"-6'0"	Buff & grey calc. silt - very soft.	"		
6'0"-10'0"	Buff & grey calc. silt with patches fine sand - soft.	"		
10'0"-13'0"	Dark grey very shelly silt with abundant hair-like roots - very soft.	P.		
13'0"-16'0"	do.	P.		
16'0"-18'0"	Grey very calc. fine sand, grading to brown calc. sandy silt.	P.		
18'0"-20'0"	Brown & grey calc. fine silty sand - soft.	P.		
20'0"-21'6"			+	
21'6"-23'0"	Brown & grey calc. fine silty sand, inc. lime - soft.	P.		
23'0"-24'6"	do.	P.	+	
24'6"-26'0"	Brown & grey patchy calc. silt.	Imp.		
26'0"-27'6"	Brown & red sand pockets in brown & grey patchy calc. silt.			
27'6"-29'0"	Red-brown silt, mottled grey.	Imp.	+	
29'0"- ?	do.	Imp.		

AUGUSTA SALT WORKS.

BORE NO. 55A.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-3'0"	L. brown to cream silt - soft.	M.L.P.		
3'0"-6'0"	Grey shelly slightly silty sand.	P.		
6'0"-10'0"	Grey organic silt - abundant fibrous roots. Very soft.	P.		
10'0"-12'0"	do.	P.		
12'0"-13'0"	L. grey very calc. shelly, very fine silty sand - soft.	M.P.		
13'0"-16'0"	do.	M.P.		
16'0"-18'0"	Khaki very calc. shelly silt - firm.	R.L.P.		
18'0"-19'6"	L. brown & grey patchy silt, calc. - Firm.	L.P.	+	
19'6"-21'0"	do.	L.P.	+	
21'0"-22'0"	Yellow, brown shelly silt - firm.	Imp.		
22'0"-23'0"	do.			
23'0"-24'6"	Brown & cream calc. fine sandy silt with very calc. patches.	Imp.	+	

BORE NO. 56.

Depth.	Description.	Perm.	Tube Rec.	No. of Blows.
0'-1'0"	Red-brown very calc. silt.	L.P.		14
1'0"-2'0"	do.	"		10
2'0"-3'0"	do.	M.P.		1
3'0"-4'6"	do.	L.P.	+	6
4'6"-6'0"	do.	M.L.P.		2
6'0"-7'0"	do.	"		4
7'0"-8'0"	do.	"		4
8'0"-9'6"	do.	"	+	7
9'6"-11'0"	do.	"		8
11'0"-12'0"	do.	"		8
12'0"-13'0"	Brown calc. silt.	"		8
13'0"-14'6"	Brown calc. silt with limestone nodules.	"	+	14
14'6"-16'0"	do.	L.P.		14

The following are attached to the other copies of this report:-

Plans - Department of Mines

Augusta Salt Ltd.

Location of boreholes -

Grid 11 - Hd. Davenport - No. L62 132.
Grid 37 - Hd. Davenport - No. 62 593.

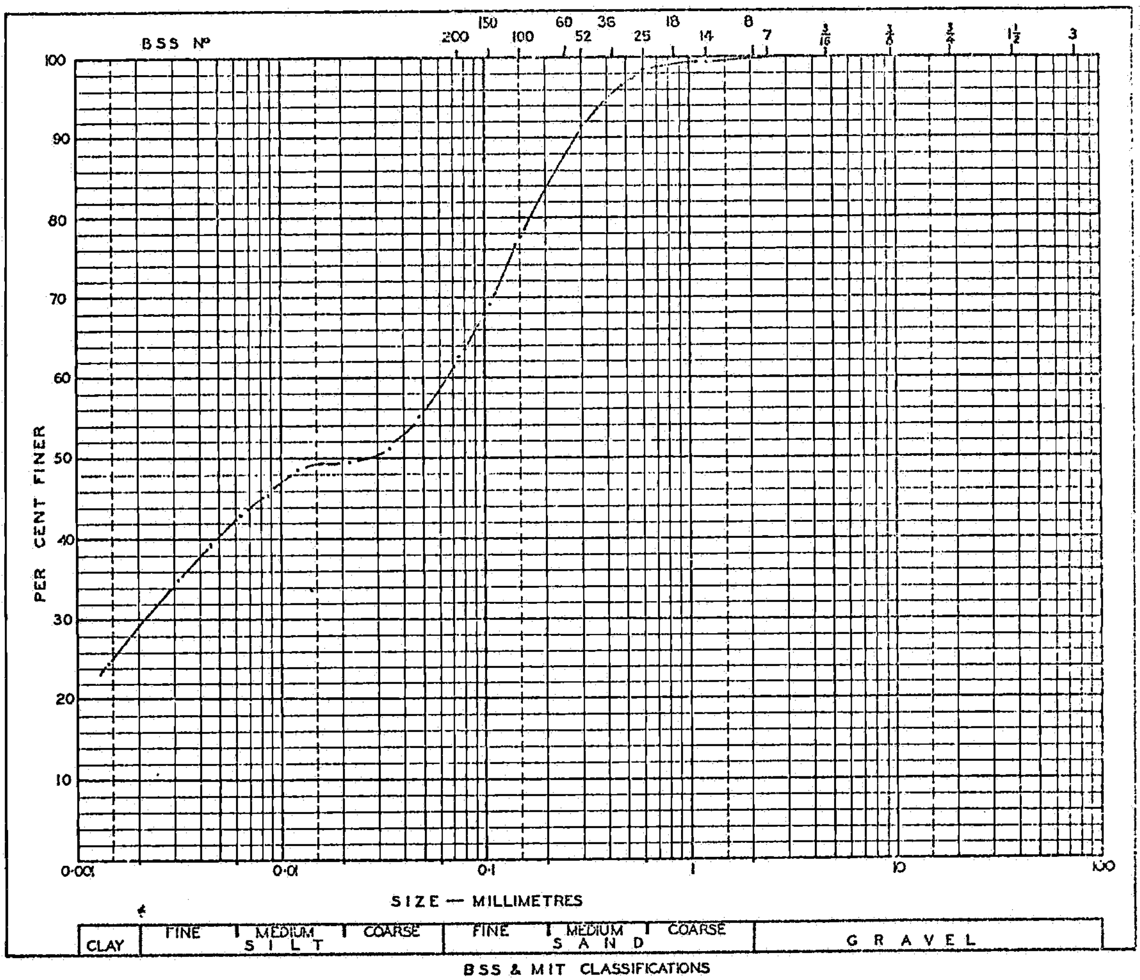
Alexander and Symonds.

Survey Plan - Unnumbered.
(75" x 40")

Report - Test Boring of Clay Deposits -

Hundreds Davenport and Winninowie
(Augusta Salt Ltd.)
by J.G. Oliver. D.M. 794/62.

SAMPLE Nº..............



JOB *AUGUSTA SALT CO.*	THE ENGINEERING AND WATER SUPPLY DEPARTMENT. MECHANICAL ANALYSIS
LOCATION	
REFERENCE	
DATE *10. 7. 62.*	SAMPLE Nº. *T.H.s 10, 11, 12, 13*
OPERATOR *G. C.*	

Specific gravity..................

Liquid limit ...35·9...

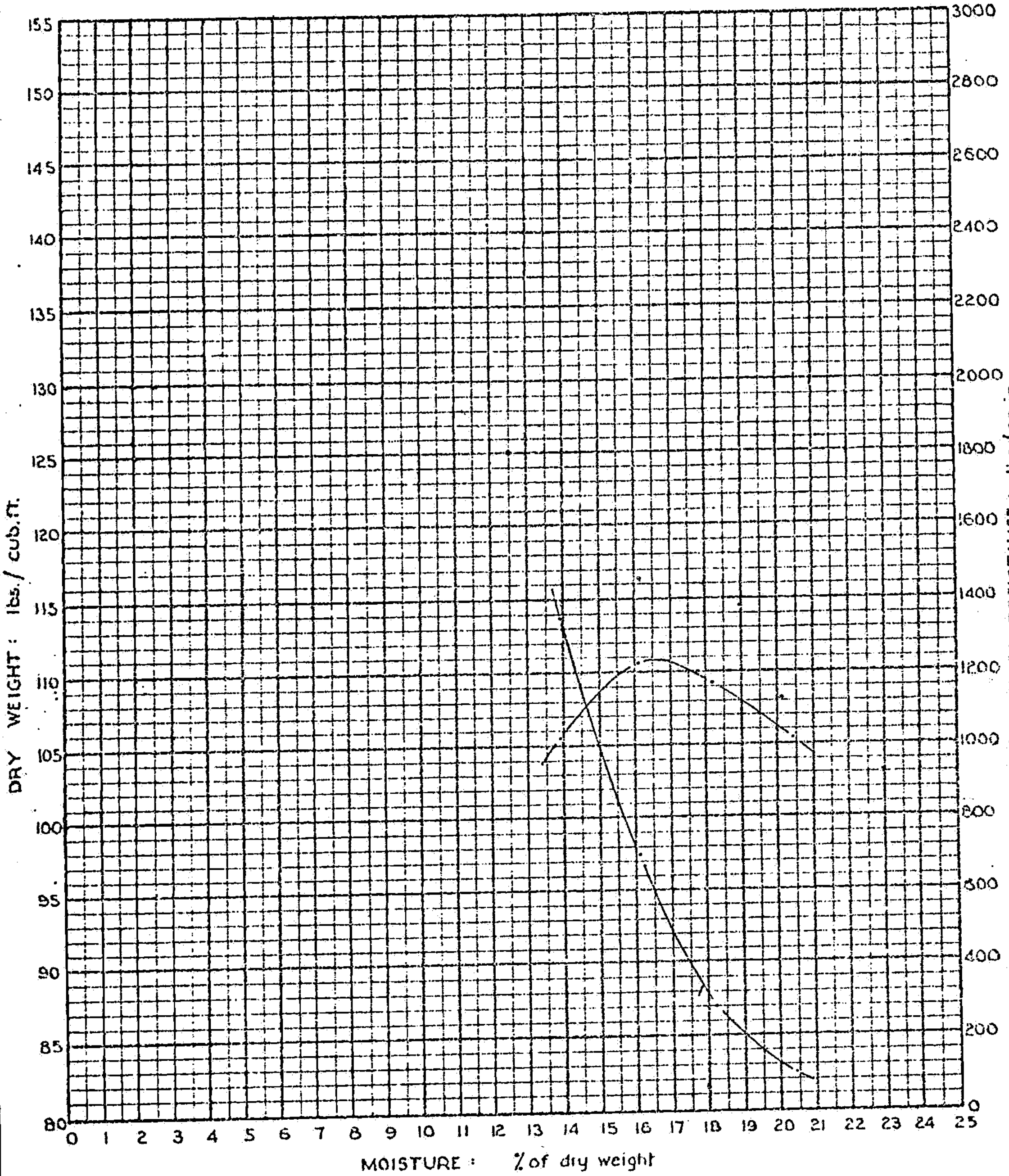
Plastic limit.....16·1...

Shrinkage limit....12·1...

Plasticity index.....19·8

Shrinkage ratio.....1·9

Classification ....



DATA

SPECIFIC GRAVITY :

SAMPLE PASSING SIEVE No. :

COMPACTION :

Vol. sample : cub.ft. : $\frac{1}{30}$
Blows per layer : 25
Layers : 3
Hammer wgt : lbs : $5\frac{1}{2}$
fall : ins : 12
dia : ins : 2

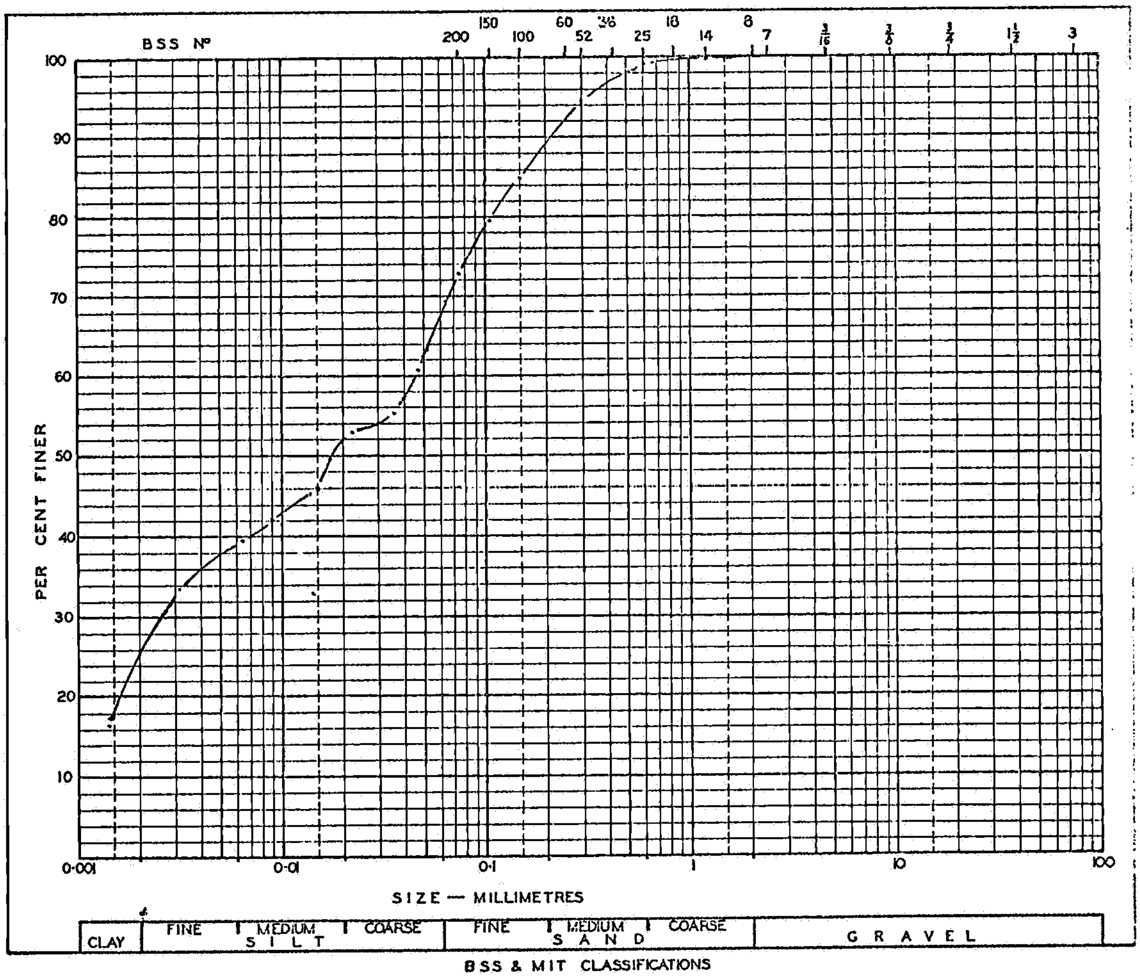
O.M.C. 16·5%
Max. D.D. 110·8 p.c.f.

THE ENGINEERING AND WATER SUPPLY DEPARTMENT

PENETRATION RESISTANCE
COMPACTION
AND
COMPLETE SATURATION CURVES

JOB AUGUSTA SALT CO.	SAMPLE No. T. H.s 10, 11, 12, 13
LOCATION	
REFERENCE	
DATE 5. 7. 62.	
OPERATOR D.C.M.	

SAMPLE No. 039



JOB *AUGUSTA SALT CO.*	THE ENGINEERING AND WATER SUPPLY DEPARTMENT MECHANICAL ANALYSIS
LOCATION	
REFERENCE	
DATE *10. 7. 62.*	SAMPLE No. *Borrow Area T.H. 15*
OPERATOR *G. C.*	

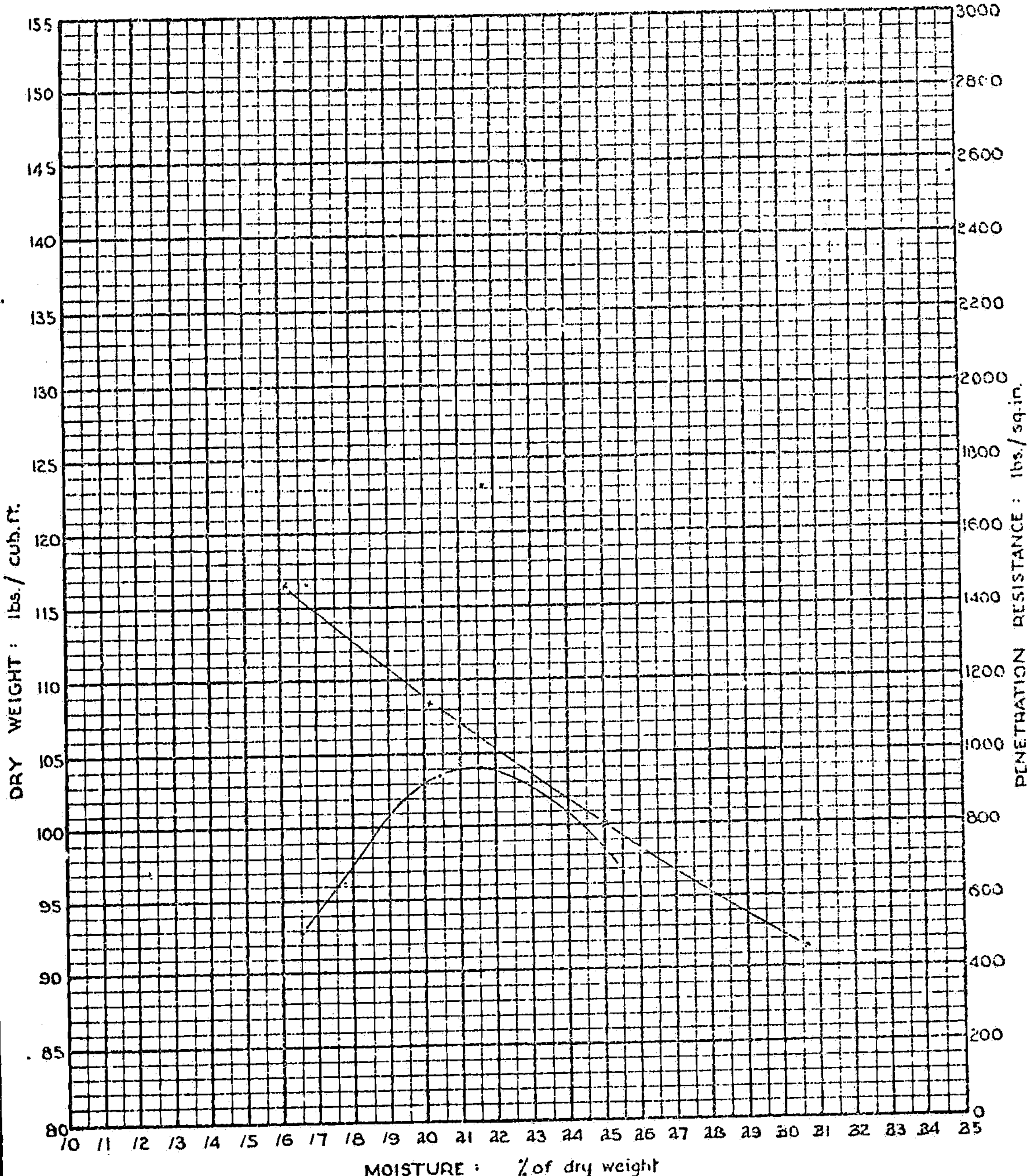
[illegible] ...... [illegible] *21.*

[illegible] *40* ...... [illegible] *1·84*

[illegible] *19* ...... [illegible] ......

[illegible] limit *15*

SAMPLE No. 040



Harvard miniature compaction apparatus.

DATA

SPECIFIC GRAVITY : 2.67

SAMPLE PASSING SIEVE N° : 3/16"

COMPACTION :

Vol. sample : cub.ft. : 1/454

Blows per layer : 25

Layers : 5

Hammer wgt: lbs: Tamper

fall : ins: 20lbs./ 0.2in.²

dia : ins :

O.M.C. 21.4

Maximum Dry Density 104.0 lbs./c.ft.

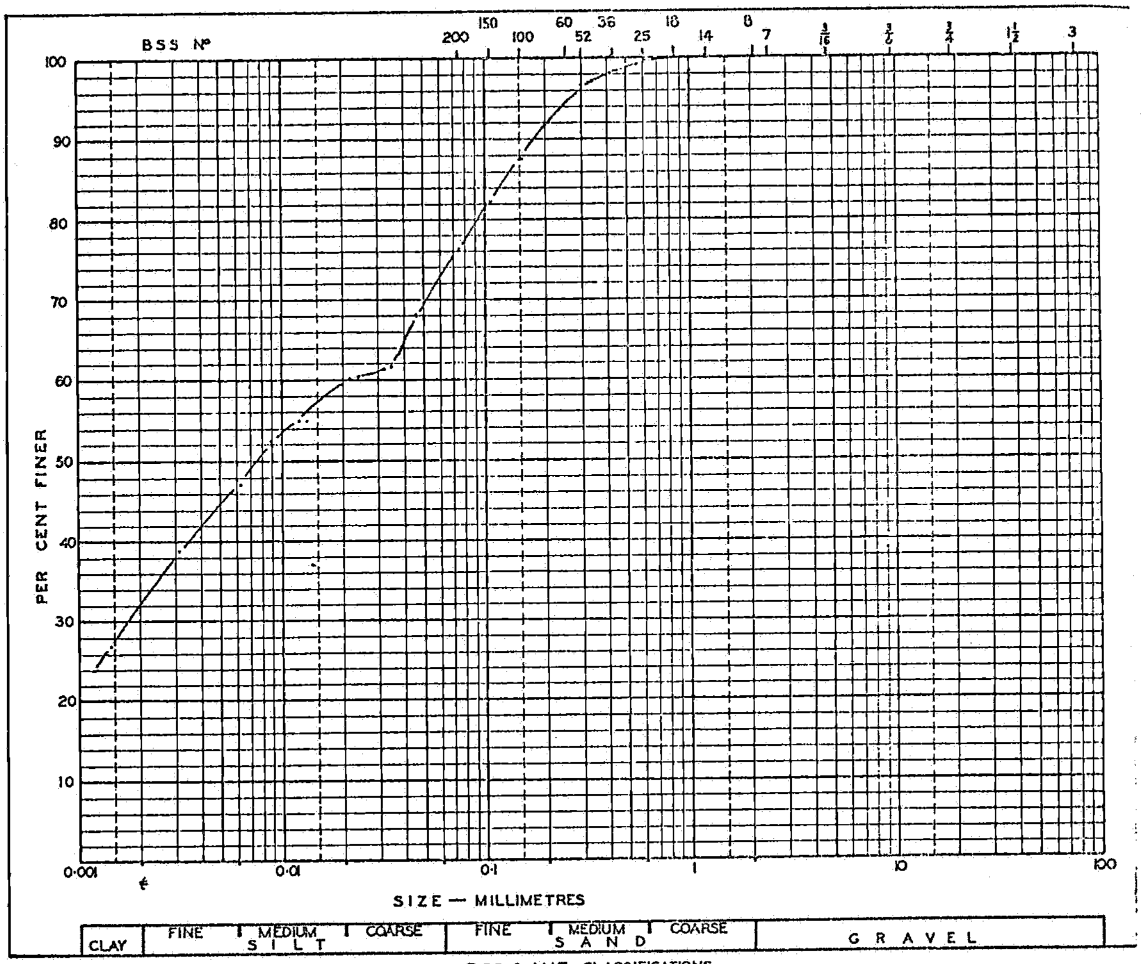
THE ENGINEERING AND WATER SUPPLY DEPARTMENT

PENETRATION RESISTANCE
COMPACTION
AND
COMPLETE SATURATION CURVES

JOB	AUGUSTA SALT CO.
LOCATION	PT. AUGUSTA.
REFERENCE	
DATE	12 - 7 - '62
OPERATOR	[illegible]

SAMPLE N° Trial Hole No 15
M.L. 132

SAMPLE No.................



BSS & MIT CLASSIFICATIONS

JOB *AUGUSTA SALT CO.*	THE ENGINEERING AND WATER SUPPLY DEPARTMENT MECHANICAL ANALYSIS
LOCATION	
REFERENCE	
DATE *10. 7. 62.*	SAMPLE No. *T.Hs 30, 35, 46*
OPERATOR *G. C.*	

Specific gravity..................

Liquid limit 45·5

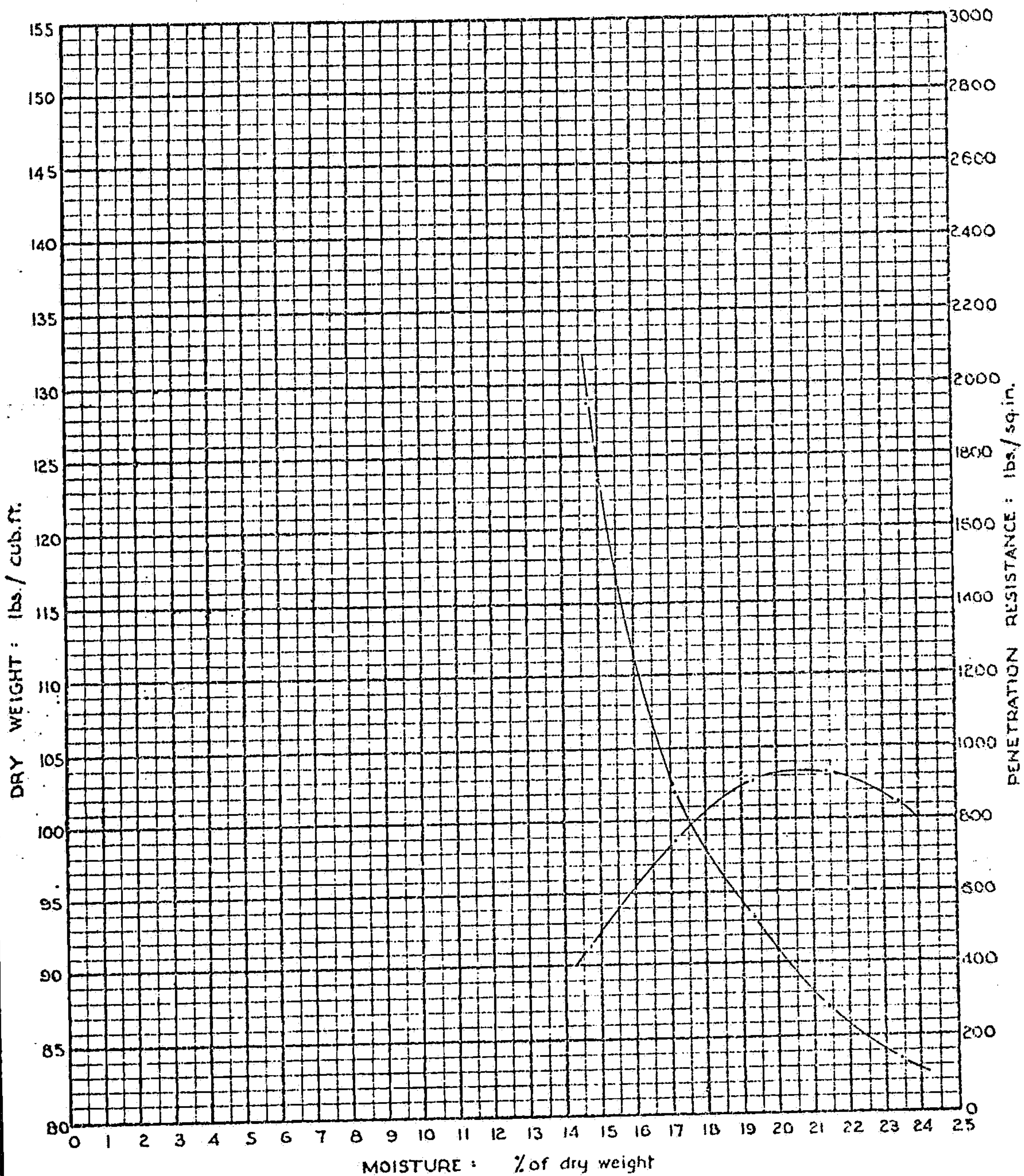
Plastic limit 17·6

Shrinkage limit 12·8

Plasticity index 27·8

Shrinkage ratio 1·93

Classification ....



DATA

SPECIFIC GRAVITY :

SAMPLE PASSING SIEVE Nº :

COMPACTION :

Vol. sample : cub.ft. :		$\frac{1}{30}$
Blows per layer :		25
Layers :		3
Hammer	wgt : lbs :	$5\frac{1}{2}$
	fall : ins :	12
	dia : ins :	2

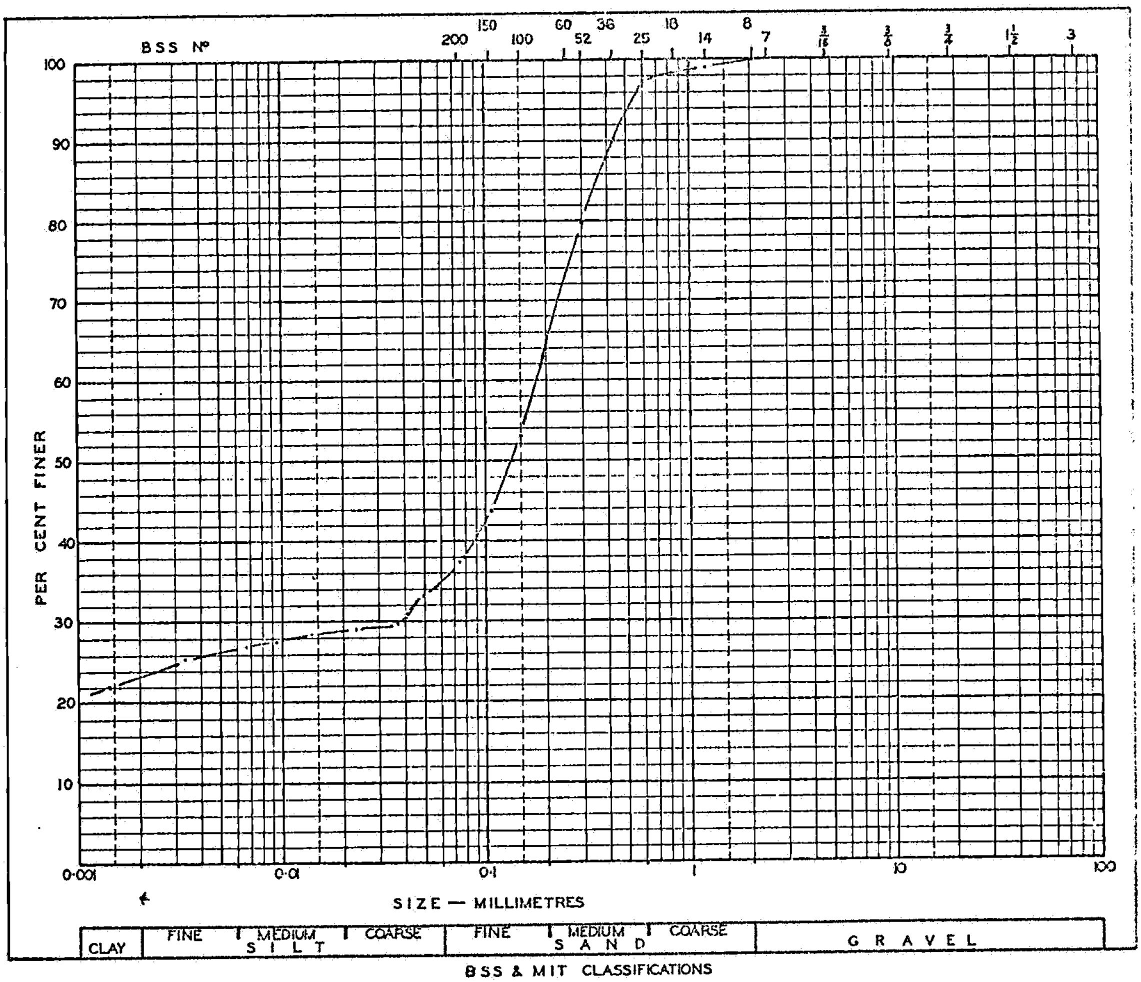
O.M.C. 20·5 %
Max. D.D. 103·4 p.c.f.

THE ENGINEERING AND WATER SUPPLY DEPARTMENT

PENETRATION RESISTANCE
COMPACTION
AND
COMPLETE SATURATION CURVES

JOB AUGUSTA SALT CO.	SAMPLE Nº
LOCATION	T.H.s 30, 35, 46
REFERENCE	
DATE 5. 7. 62.	
OPERATOR A. K.	

SAMPLE Nº 043



JOB *AUGUSTA SALT CO.*	THE ENGINEERING AND WATER SUPPLY DEPARTMENT MECHANICAL ANALYSIS
LOCATION	
REFERENCE	
DATE *10. 7. 62.*	SAMPLE Nº *12 D/2005* *1'-0" — 6'-0"*
OPERATOR *G. C.*	

Specific gravity ....

Plasticity index *10*

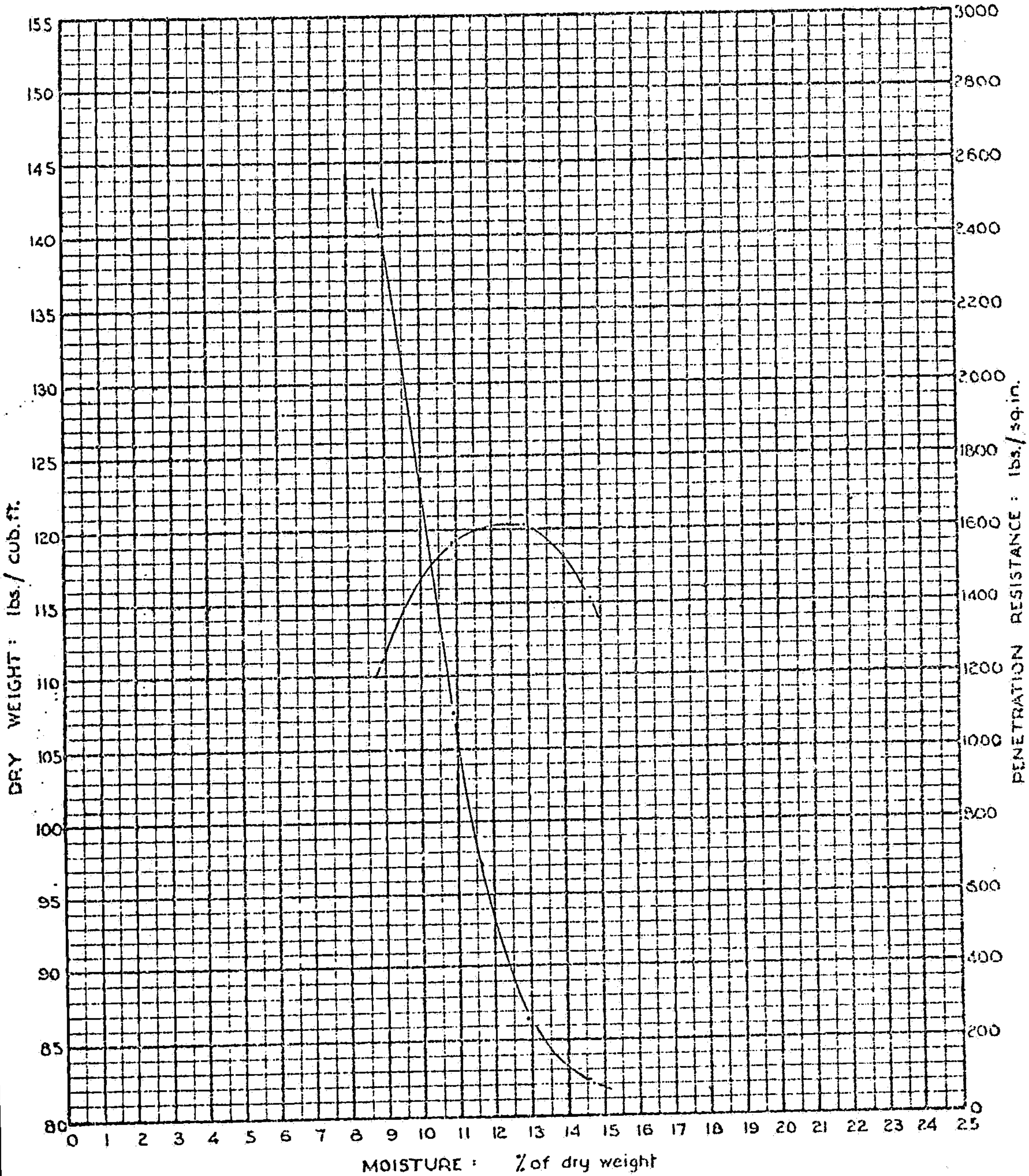
Liquid limit *23*

Shrinkage ratio *1·87*

Plastic limit *13*

Classification ....

Shrinkage limit *14·5*



THE ENGINEERING AND WATER SUPPLY DEPARTMENT

PENETRATION RESISTANCE
COMPACTION
AND
COMPLETE SATURATION CURVES

DATA

SPECIFIC GRAVITY :

SAMPLE PASSING SIEVE N° :

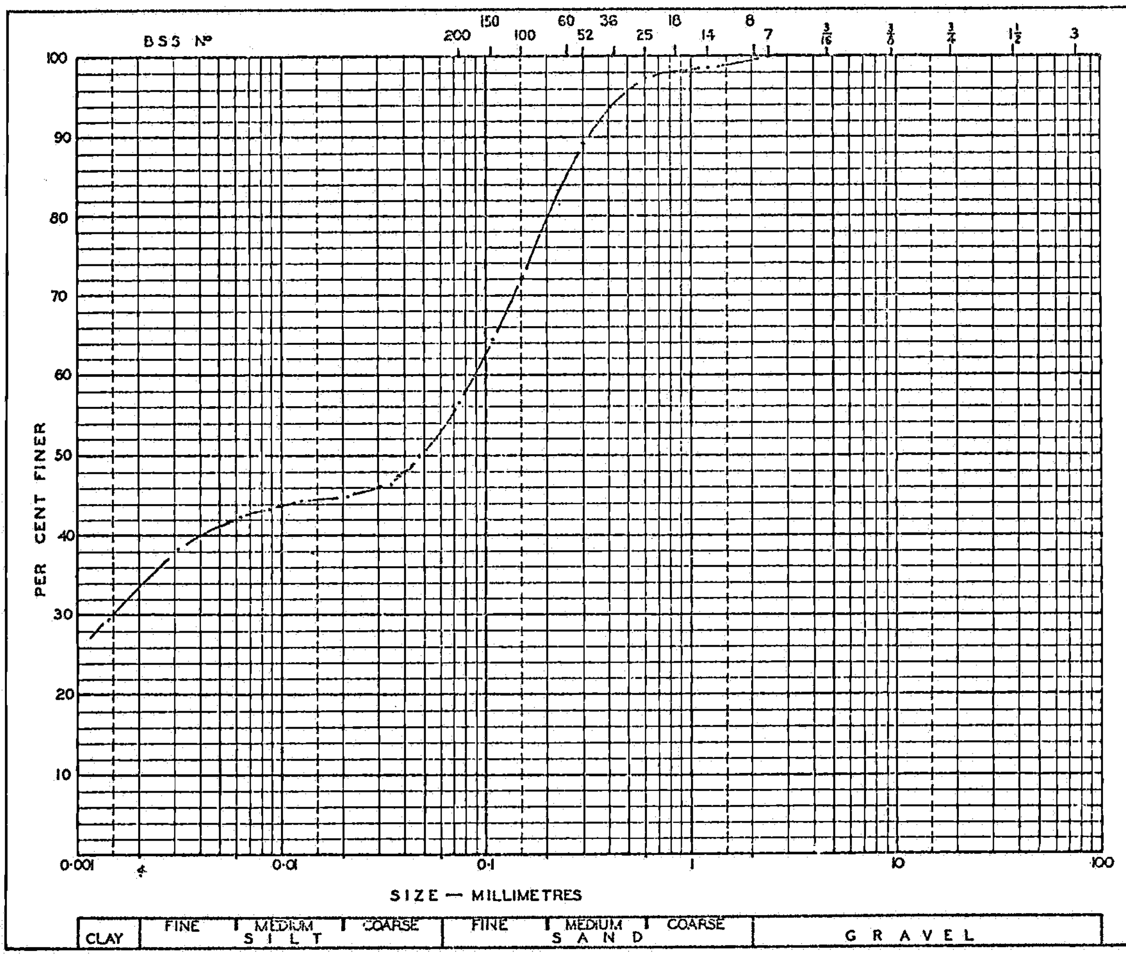
COMPACTION :

Vol. sample : cub. ft. :		1/30
Blows per layer :		25
Layers :		3
Hammer	wgt : lbs :	5½
	fall : ins :	12
	dia : ins :	2

O.M.C. 12·5 %
Max. D.D. 120·3 p.c.f.

JOB	*AUGUSTA SALT CO.*	SAMPLE N° *12D/2005* *1'-0" — 6'-0"*
LOCATION		
REFERENCE		
DATE	*11. 7. 62.*	
OPERATOR	*A.K.*	

SAMPLE Nº........... 045



B S S & M I T CLASSIFICATIONS

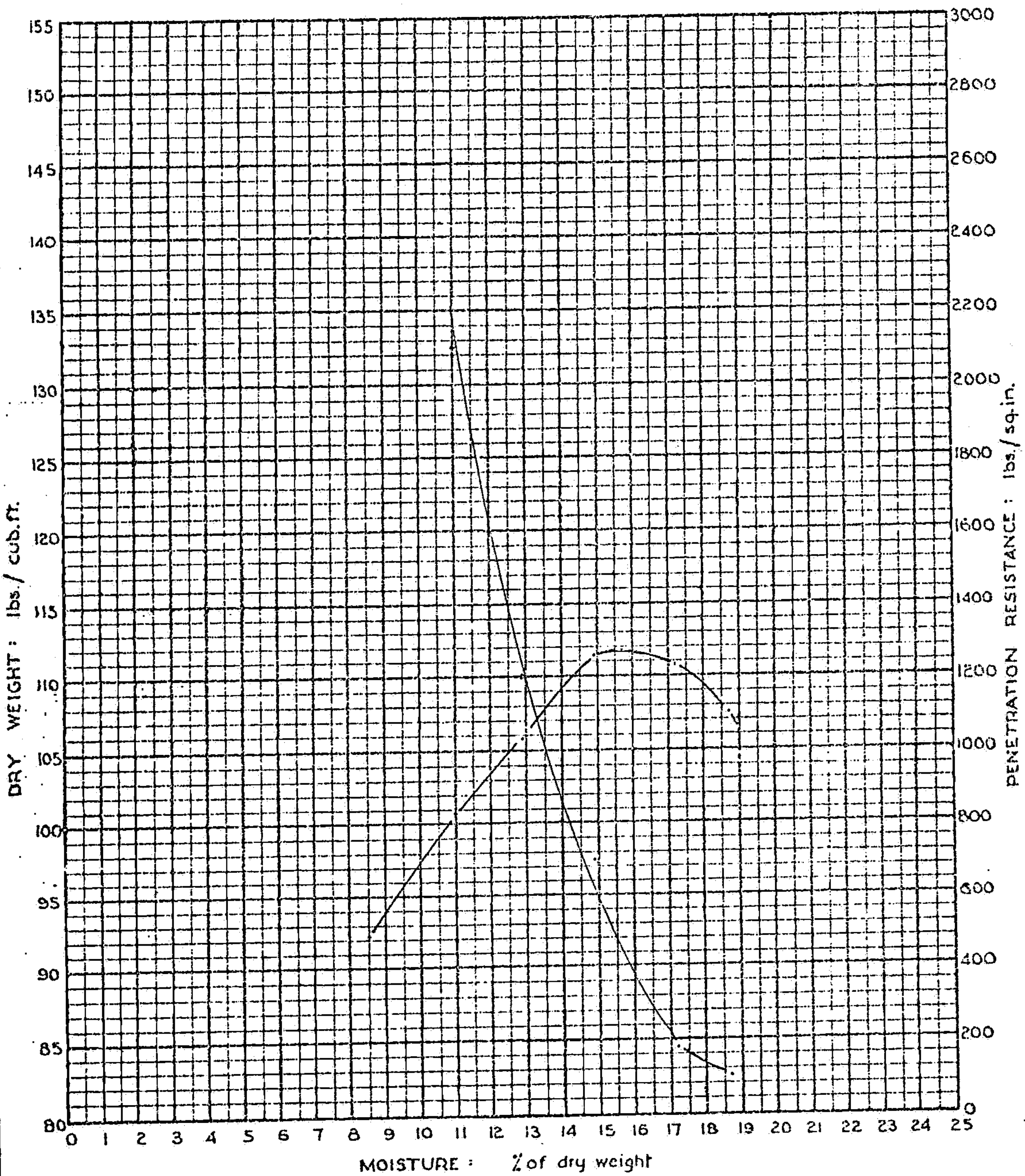
JOB *AUGUSTA SALT CO.*	THE ENGINEERING AND WATER SUPPLY DEPARTMENT
LOCATION	MECHANICAL ANALYSIS
REFERENCE	
DATE *10. 7. 62*	SAMPLE Nº. *12 D/200 S* *6'-0"—10'-0"*
OPERATOR *G.C.*	

[illegible] 22

[illegible] 36 [illegible] 1·88

[illegible] 14 [illegible]

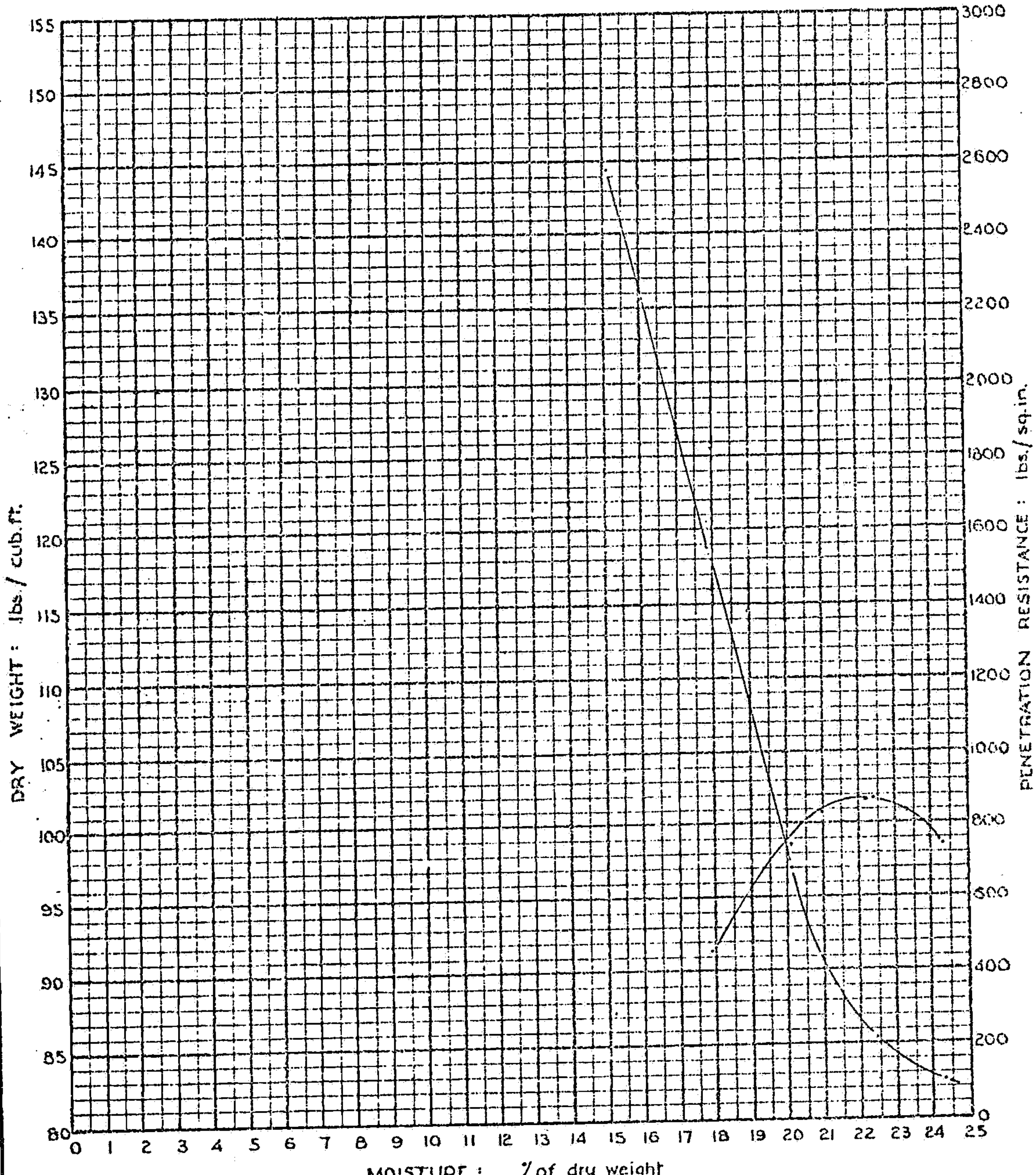
[illegible] 13



DATA	THE ENGINEERING AND WATER SUPPLY DEPARTMENT
SPECIFIC GRAVITY :	PENETRATION RESISTANCE COMPACTION AND COMPLETE SATURATION CURVES
SAMPLE PASSING SIEVE N° :	JOB AUGUSTA SALT CO.
COMPACTION :	LOCATION
Vol. sample : cub.ft. : 1/30	REFERENCE
Blows per layer : 25	DATE 11. 7. 62.
Layers : 3	OPERATOR A.K.
Hammer wgt : lbs : 5½	SAMPLE N° 12D/200S 6'-0"–10'-0'
fall : ins : 12	
dia : ins : 2	
O.M.C. 15·5 %	
Max.D.D. 111·8 p.c.f.	

SAMPLE No.

047



DATA

SPECIFIC GRAVITY :

SAMPLE PASSING SIEVE N° :

COMPACTION :

Vol. sample : cub.ft. : $\frac{1}{30}$

Blows per layer : 25

Layers : 3

Hammer wgt : lbs : $5\frac{1}{2}$

fall : ins : 12

dia : ins : 2

O.M.C. 22·0%

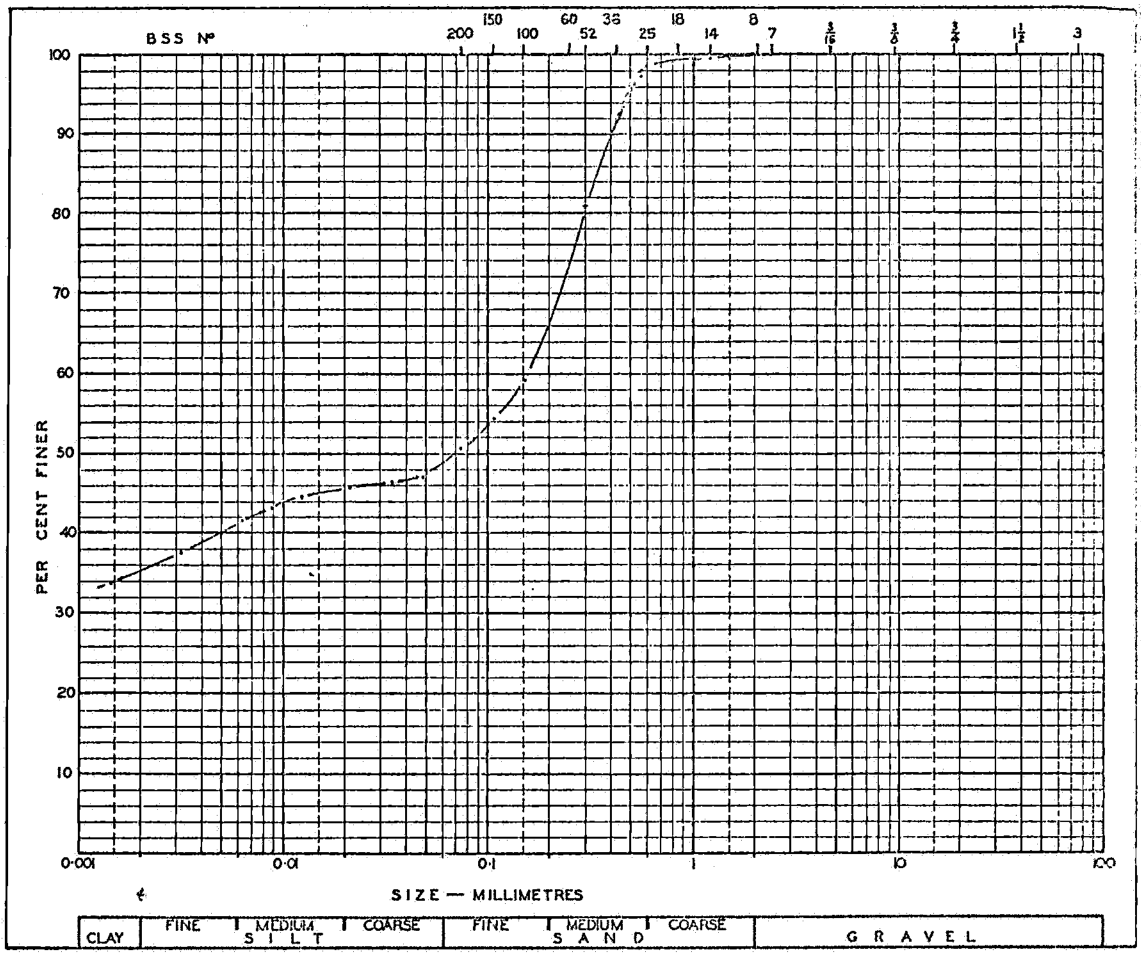
Max. D.D. 101·8 p.c.f.

THE ENGINEERING AND WATER SUPPLY DEPARTMENT

PENETRATION RESISTANCE
COMPACTION
AND
COMPLETE SATURATION CURVES

JOB AUGUSTA SALT CO.	SAMPLE N° 12D/400 W 1'-0"—3'-0"
LOCATION	
REFERENCE	
DATE 12. 7. 62.	
OPERATOR D.C.M.	

SAMPLE Nº.................. 048



B.S.S. & M.I.T. CLASSIFICATIONS

JOB *AUGUSTA SALT CO.*	THE ENGINEERING AND WATER SUPPLY DEPARTMENT MECHANICAL ANALYSIS
LOCATION	
REFERENCE	
DATE *10. 7. 62.*	SAMPLE Nº. *12D/400 W* *1'-0" – 3'-0"*
OPERATOR *G.C.*	

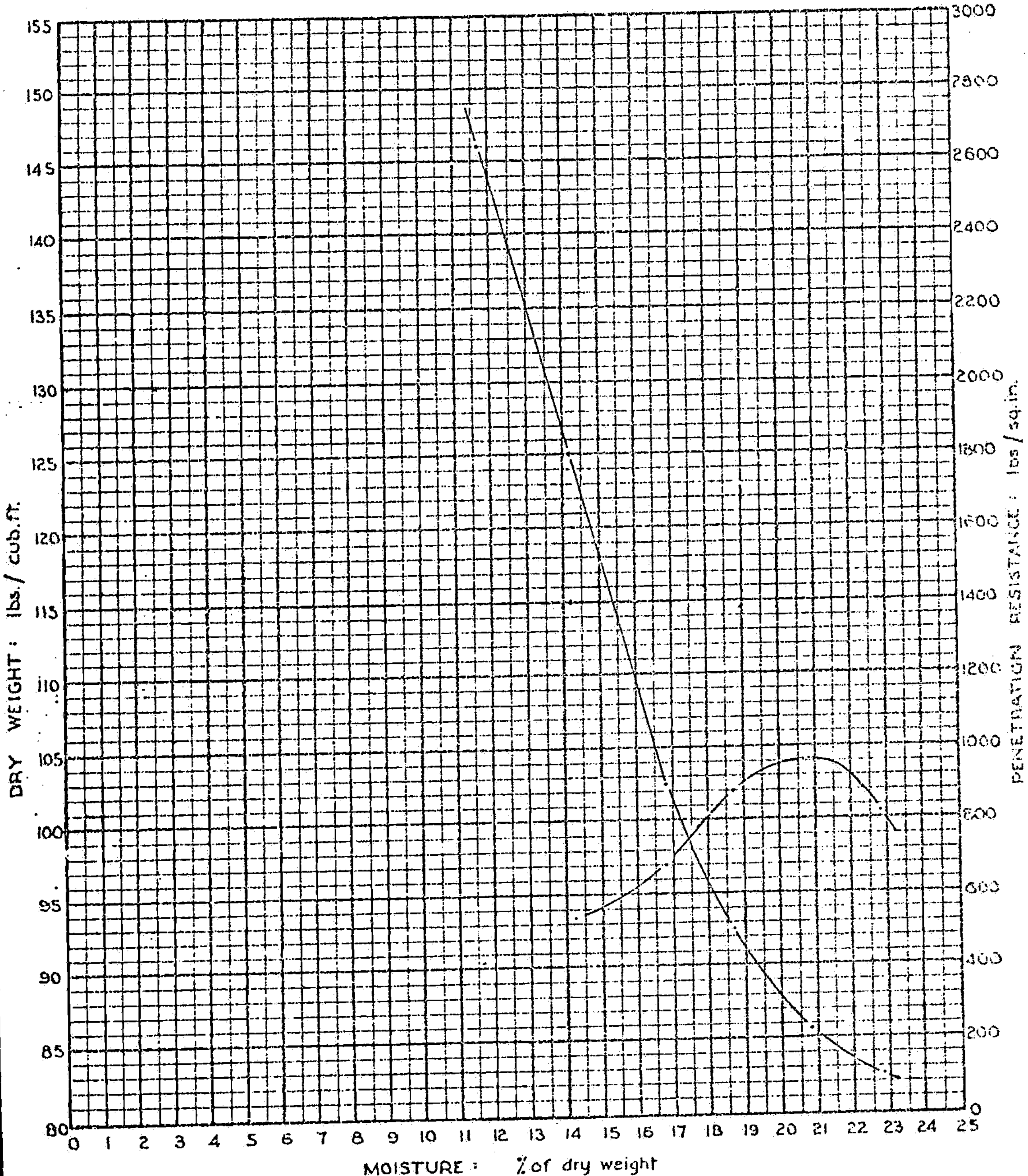
[illegible] .... [illegible] *28*

[illegible] *45* [illegible] *1·79*

[illegible] *17* [illegible]

[illegible] *16*

SAMPLE No. 049



DATA

SPECIFIC GRAVITY :

SAMPLE PASSING SIEVE N° :

COMPACTION :

Vol. sample : cub.ft. :		$\frac{1}{30}$
Blows per layer :		25
Layers :		3
Hammer	wgt : lbs :	$5\frac{1}{2}$
	fall : ins :	12
	dia : ins :	2

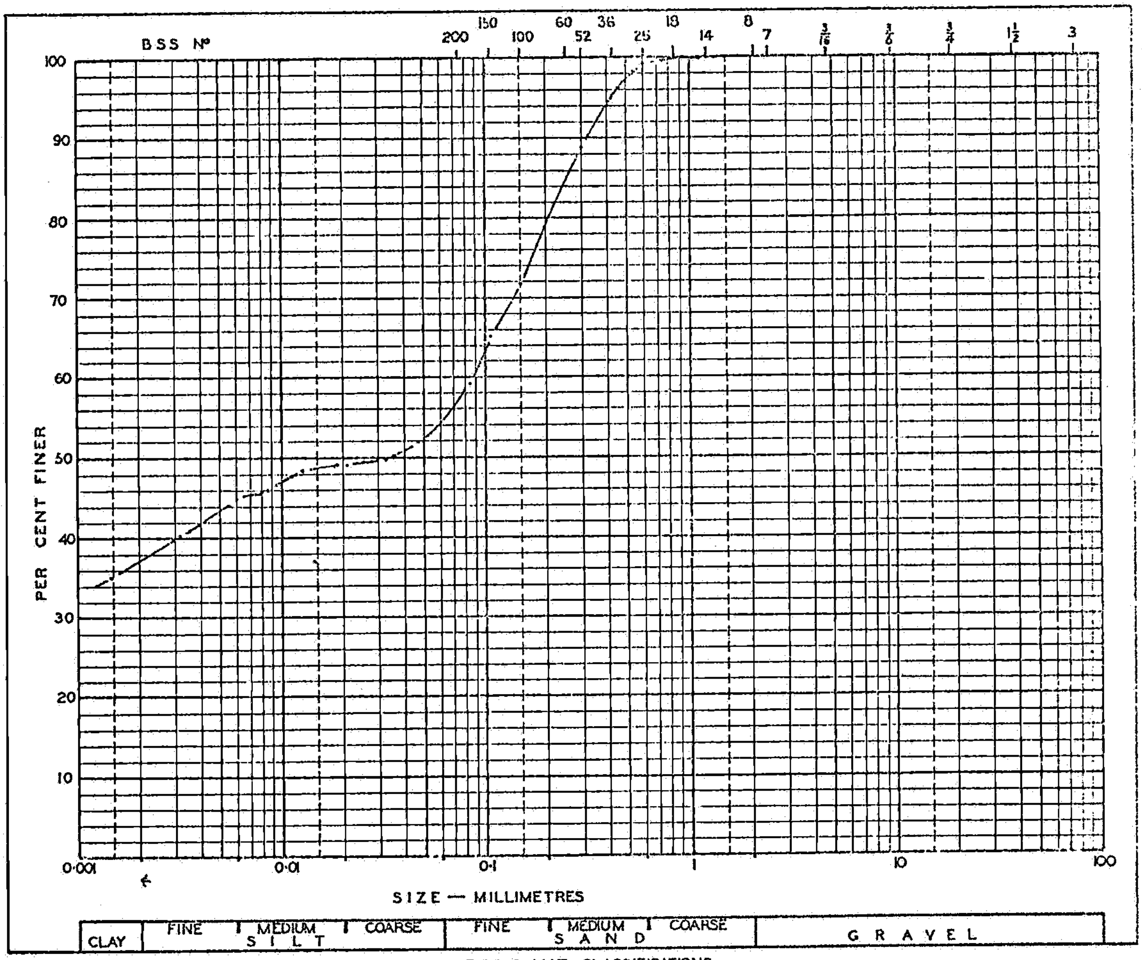
O.M.C. 21·0%
Max. D.D. 104·1 p.c.f.

THE ENGINEERING AND WATER SUPPLY DEPARTMENT

PENETRATION RESISTANCE
COMPACTION
AND
COMPLETE SATURATION CURVES

JOB *AUGUSTA SALT CO.*	SAMPLE N° *13B/200S* *2'0"–10'-0"*
LOCATION	
REFERENCE	
DATE *11. 7. 62.*	
OPERATOR *A.K.*	

SAMPLE No. 050



BSS & MIT CLASSIFICATIONS

JOB *AUGUSTA SALT CO.*	THE ENGINEERING AND WATER SUPPLY DEPARTMENT
LOCATION	MECHANICAL ANALYSIS
REFERENCE	
DATE *10. 7. 62.*	SAMPLE No. *13B/200S 2'-0"-10'-0"*
OPERATOR *G.C.*	

Specific gravity ....

Liquid limit .... *46* ....

Plastic limit .... *16* ....

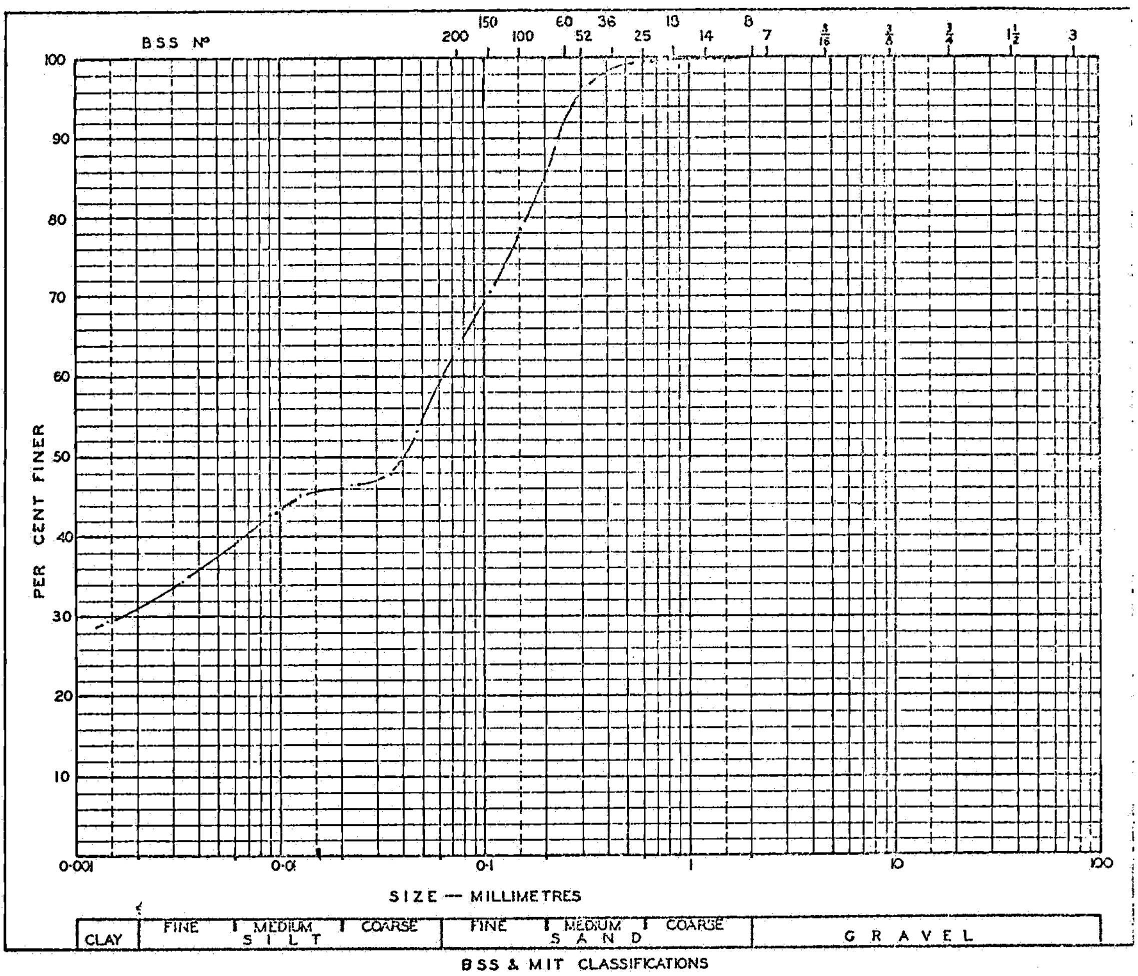
Shrinkage limit .... *13* ....

Plasticity index .. *30*

Shrinkage ratio .. *1·91*

Classification ....

SAMPLE No. 051



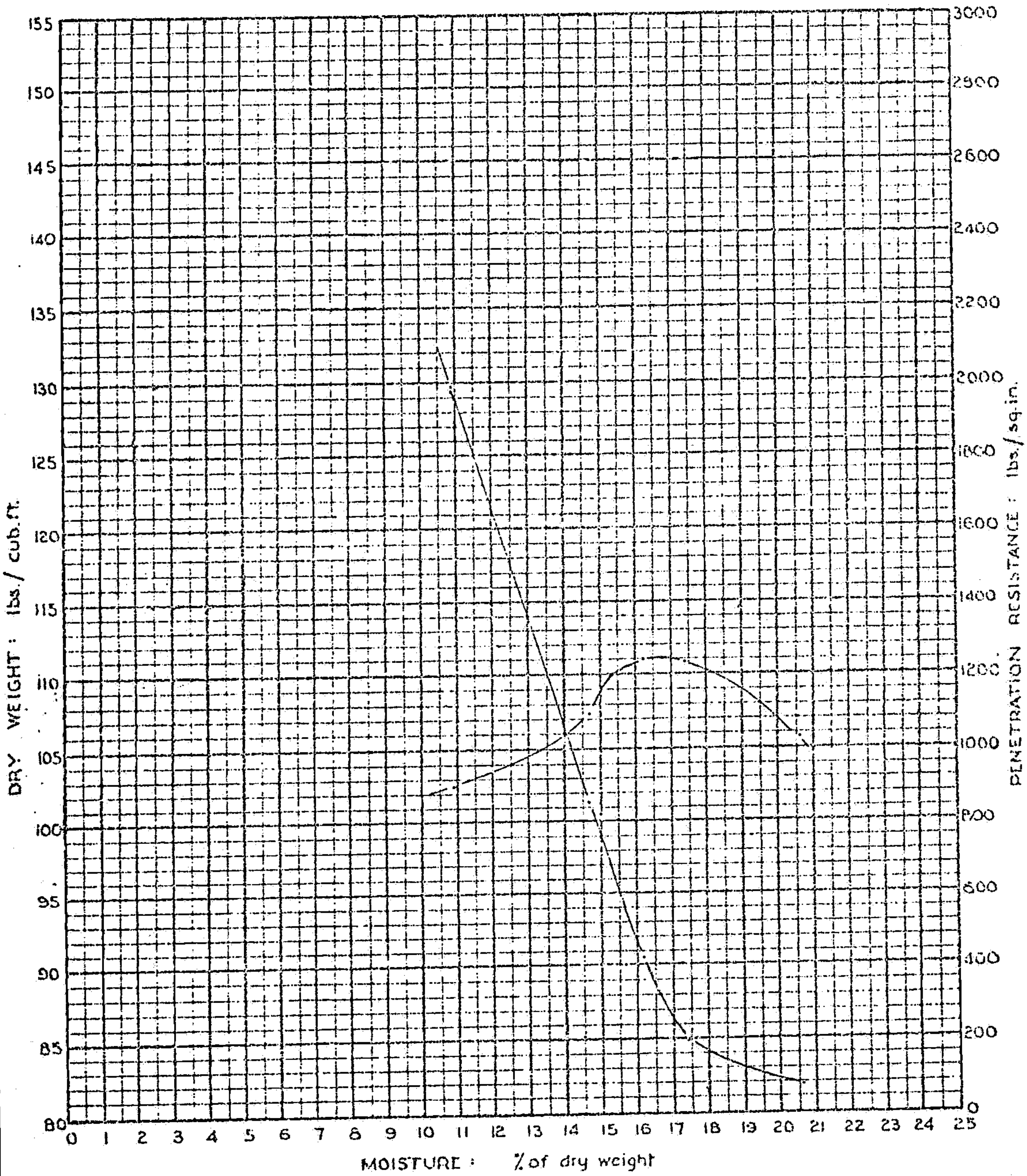
JOB *AUGUSTA SALT CO.*	THE ENGINEERING AND WATER SUPPLY DEPARTMENT
LOCATION	MECHANICAL ANALYSIS
REFERENCE	
DATE *18. 6. 62*	SAMPLE No. *ML 129/1 No. 1* *T.H. A200 W 0'–10'-0"*
OPERATOR *G.C.*	

Specific gravity ....
Liquid limit *34*
Plastic limit *13*
Shrinkage limit *11·5*

Plasticity index *21*
Shrinkage ratio *1·96*
Classification ....

SAMPLE NO.

L · 052



DATA

SPECIFIC GRAVITY :

SAMPLE PASSING SIEVE Nº :

COMPACTION :

Vol. sample : cub.ft. : 1/30
Blows per layer : 25
Layers : 3
Hammer wgt : lbs : 5½
fall : ins : 12
dia : ins : 2

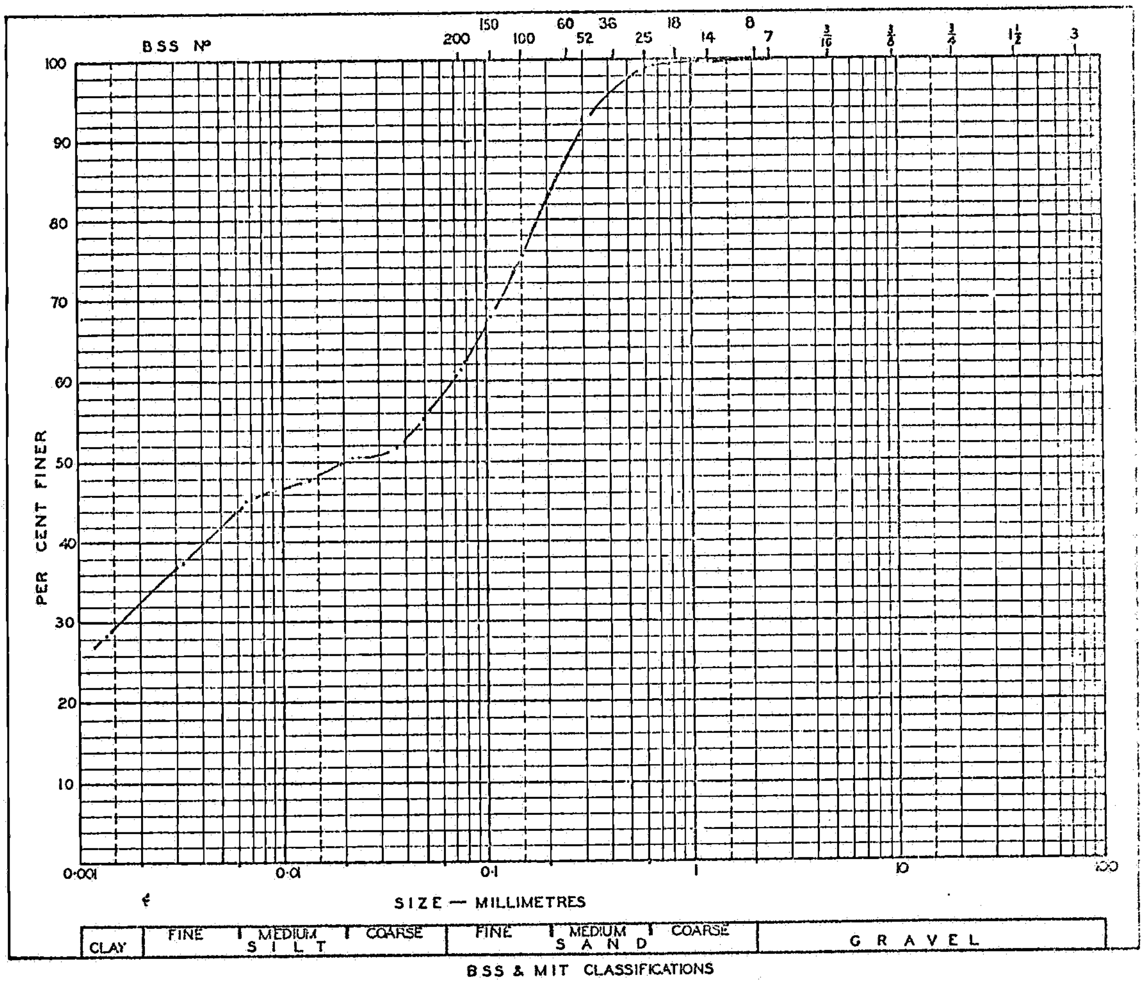
In-situ M.C. 18.0%
O.M.C. 16.5%
Max. D.D. 111 p.c.f.

THE ENGINEERING AND WATER SUPPLY DEPARTMENT

PENETRATION RESISTANCE
COMPACTION
AND
COMPLETE SATURATION CURVES

JOB *AUGUSTA SALT CO.*	SAMPLE Nº *ML 129/1 No. 1*
LOCATION	
REFERENCE	
DATE *21. 6. 62.*	*A200W 0'-10'-0"*
OPERATOR *D. C. M.*	

SAMPLE No. 053



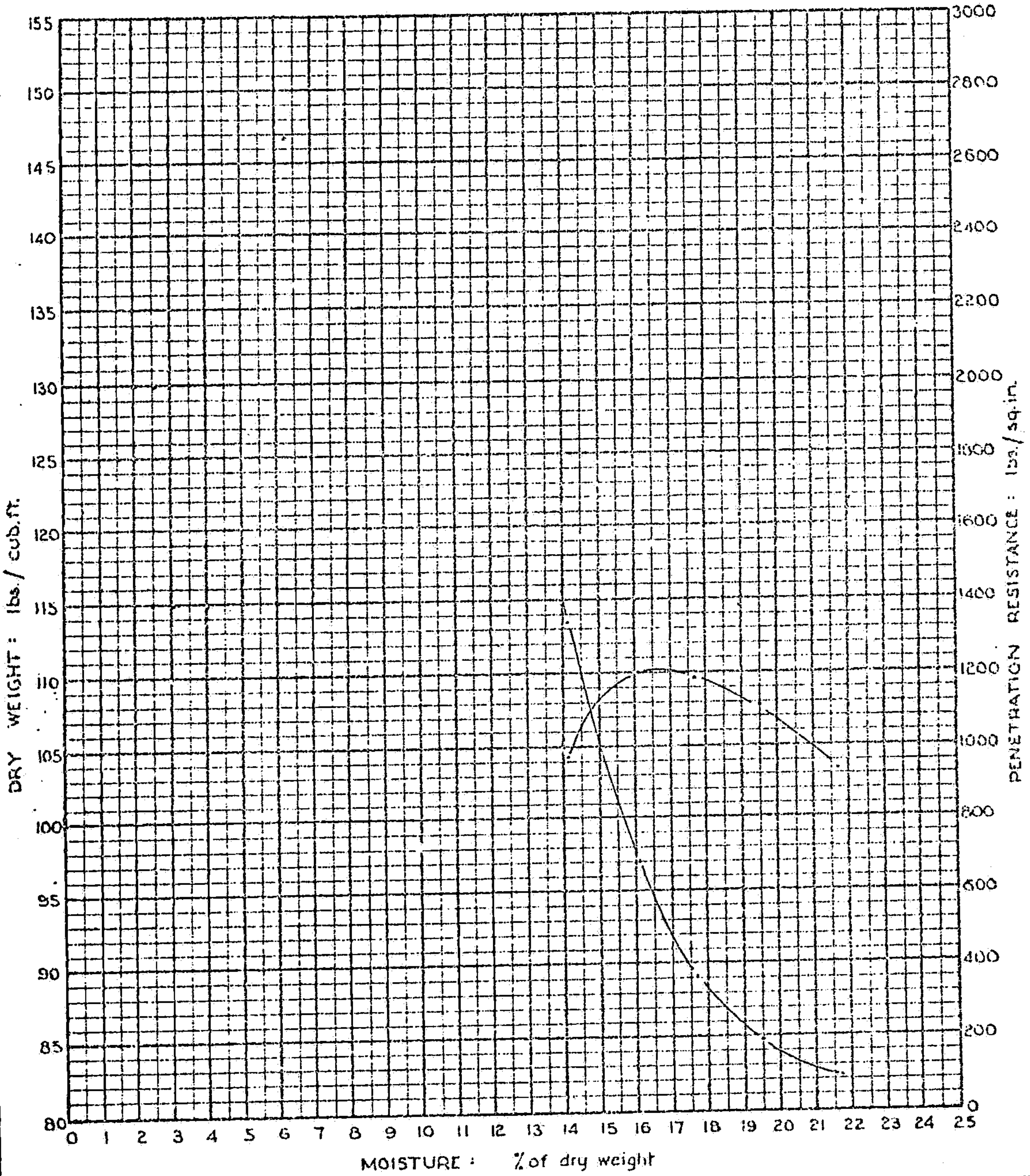
JOB *AUGUSTA SALT CO.*	THE ENGINEERING AND WATER SUPPLY DEPARTMENT
LOCATION	MECHANICAL ANALYSIS
REFERENCE	
DATE *18. 6. 62.*	SAMPLE No. *ML 129/2 No. 3* *T.H. A200W 0'—10'-0"*
OPERATOR *G. C.*	

Specific gravity .... Plasticity index *24*

Liquid limit *39* Shrinkage ratio *1·90*

Plastic limit *15* Classification ....

Shrinkage limit *13·0*



DATA	THE ENGINEERING AND WATER SUPPLY DEPARTMENT

DATA

SPECIFIC GRAVITY :

SAMPLE PASSING SIEVE No. :

COMPACTION :

Vol. sample : cub.ft. :	$\frac{1}{30}$
Blows per layer :	25
Layers :	3
Hammer wgt : lbs :	$5\frac{1}{2}$"
fall : ins :	12
dia : ins :	2

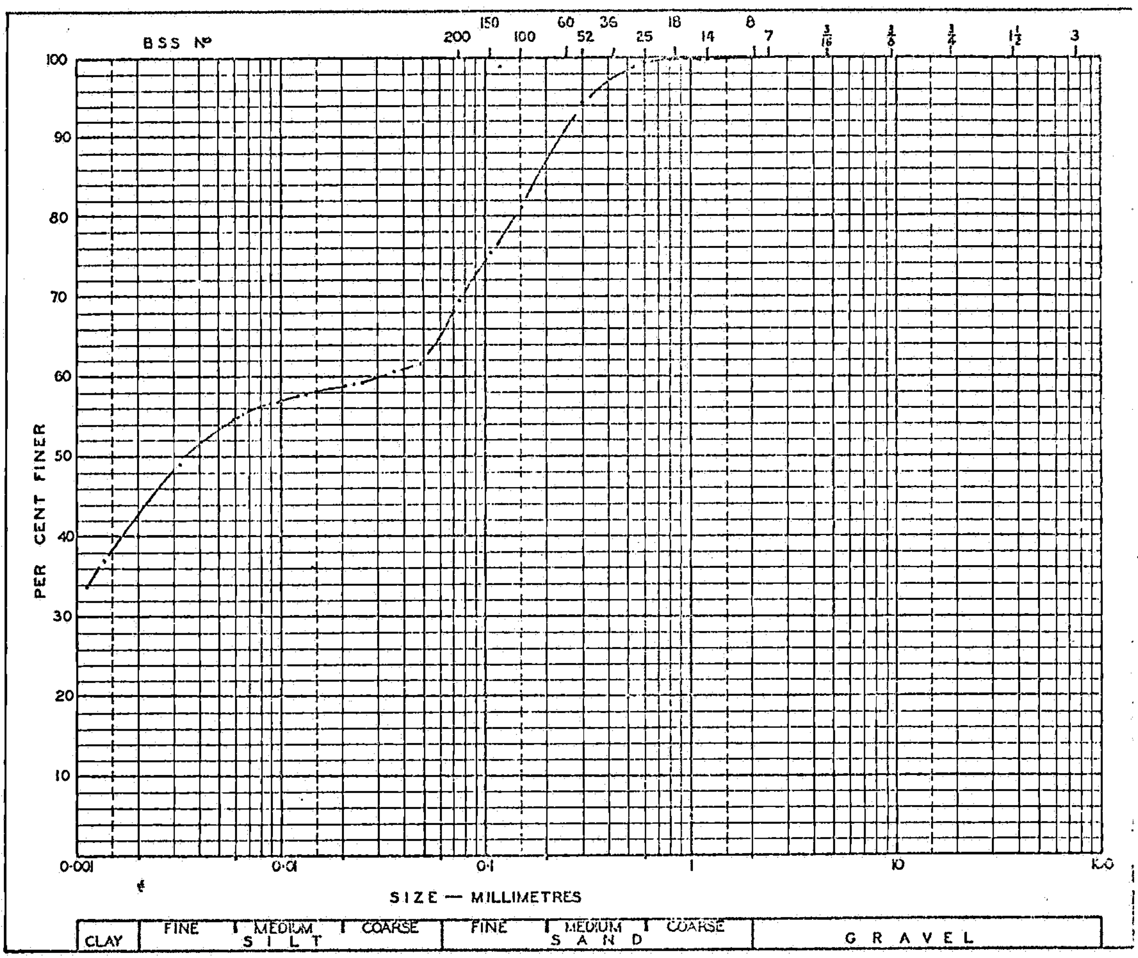
O.M.C. 16·5%
Max. D.D. 110·1 p.c.f.

THE ENGINEERING AND WATER SUPPLY DEPARTMENT

PENETRATION RESISTANCE
COMPACTION
AND
COMPLETE SATURATION CURVES

JOB AUGUSTA SALT CO.	SAMPLE No. ML 129/2
LOCATION	No. 3
REFERENCE	
DATE 18. 6. 62.	A 200 W
OPERATOR D.C.M.	0'—10'-0"

SAMPLE No. 055



BSS & MIT CLASSIFICATIONS

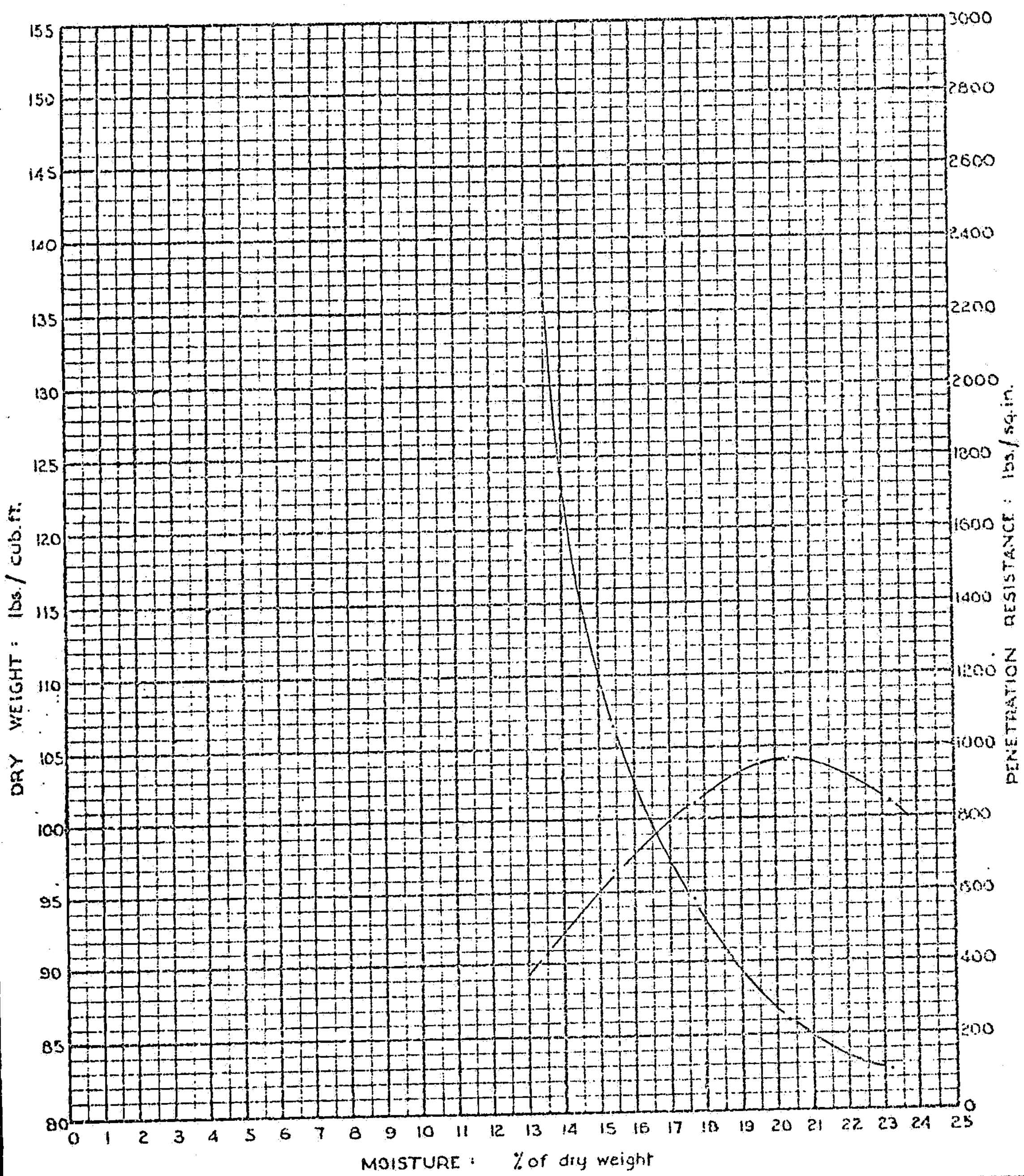
JOB *AUGUSTA SALT CO.*	THE ENGINEERING AND WATER SUPPLY DEPARTMENT
LOCATION	MECHANICAL ANALYSIS
REFERENCE	
DATE *18. 6. 62.*	SAMPLE No. *ML 129/3 No. 4* *T.H. A200W 0'– 10'-0"*
OPERATOR *G.C.*	

Specific gravity .... Plasticity index *39*

Liquid limit *54* Shrinkage ratio *1·90*

Plastic limit *15* Classification ....

Shrinkage limit *12·6*



DATA

SPECIFIC GRAVITY :

SAMPLE PASSING SIEVE Nº :

COMPACTION :

Vol. sample : cub.ft. :		$\frac{1}{30}$
Blows per layer :		25
Layers :		3
Hammer	wgt : lbs :	$5\frac{1}{2}$
	fall : ins :	12
	dia : ins :	2

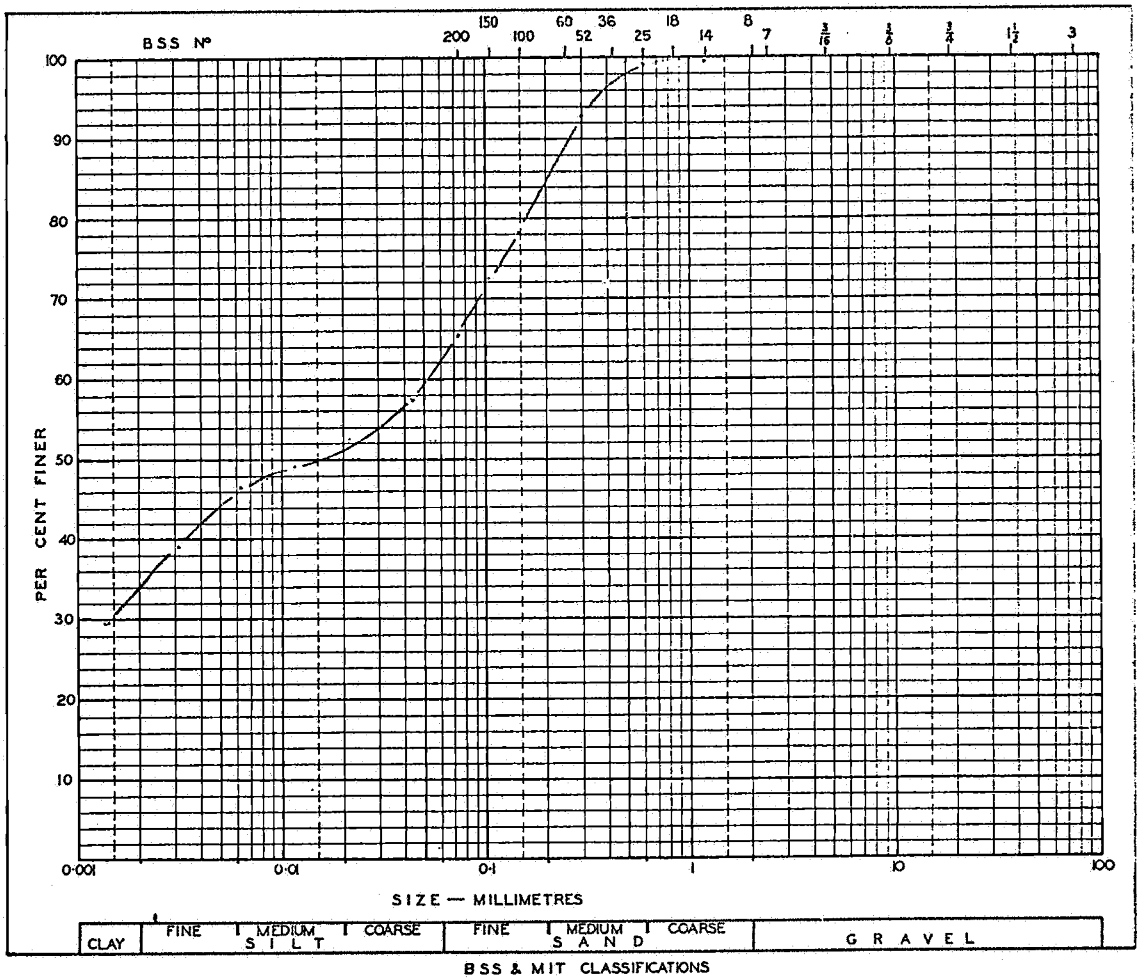
O.M.C. 20·5%
Max. D.D. 104·2 p.c.f.

THE ENGINEERING AND WATER SUPPLY DEPARTMENT

PENETRATION RESISTANCE COMPACTION AND COMPLETE SATURATION CURVES

JOB *AUGUSTA SALT CO.*	SAMPLE Nº *ML 129/3*
LOCATION	*No. 4*
REFERENCE	
DATE *22. 6. 62.*	*A 200 W* *0'—10'-0"*
OPERATOR *D.C.M.*	

SAMPLE No. 057



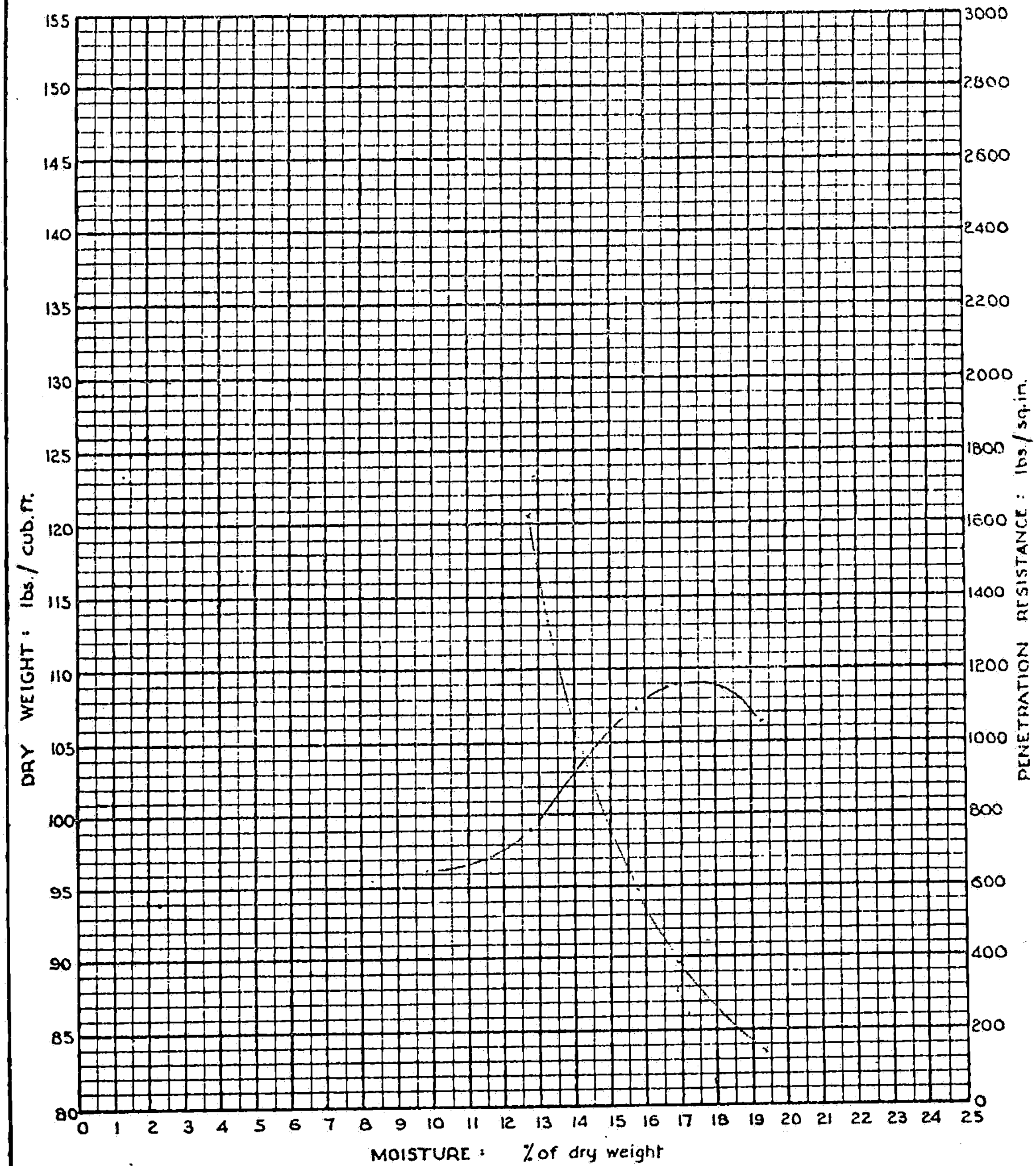
JOB Augusta Salt Co.	THE ENGINEERING AND WATER SUPPLY DEPARTMENT
LOCATION Port Augusta	MECHANICAL ANALYSIS
REFERENCE	
DATE 9. 8. 62	SAMPLE No. ML 139/1
OPERATOR G.C.	Trial Hole No 11-4L Depth 6'-18'

Specific gravity ________ Plasticity index 26

Liquid limit 40 Shrinkage ratio 1.96

Plastic limit 14 Classification ________

Shrinkage limit 12.3



DATA	THE ENGINEERING AND WATER SUPPLY DEPARTMENT
SPECIFIC GRAVITY :	PENETRATION RESISTANCE COMPACTION AND COMPLETE SATURATION CURVES
SAMPLE PASSING SIEVE No : 3/16	

COMPACTION :

Vol. sample : cub.ft. : 1/30
Blows per layer : 25
Layers : 3
Hammer wgt : lbs : 5 1/2
fall : ins : 12.
dia : ins : 2.

OMC - 17 %

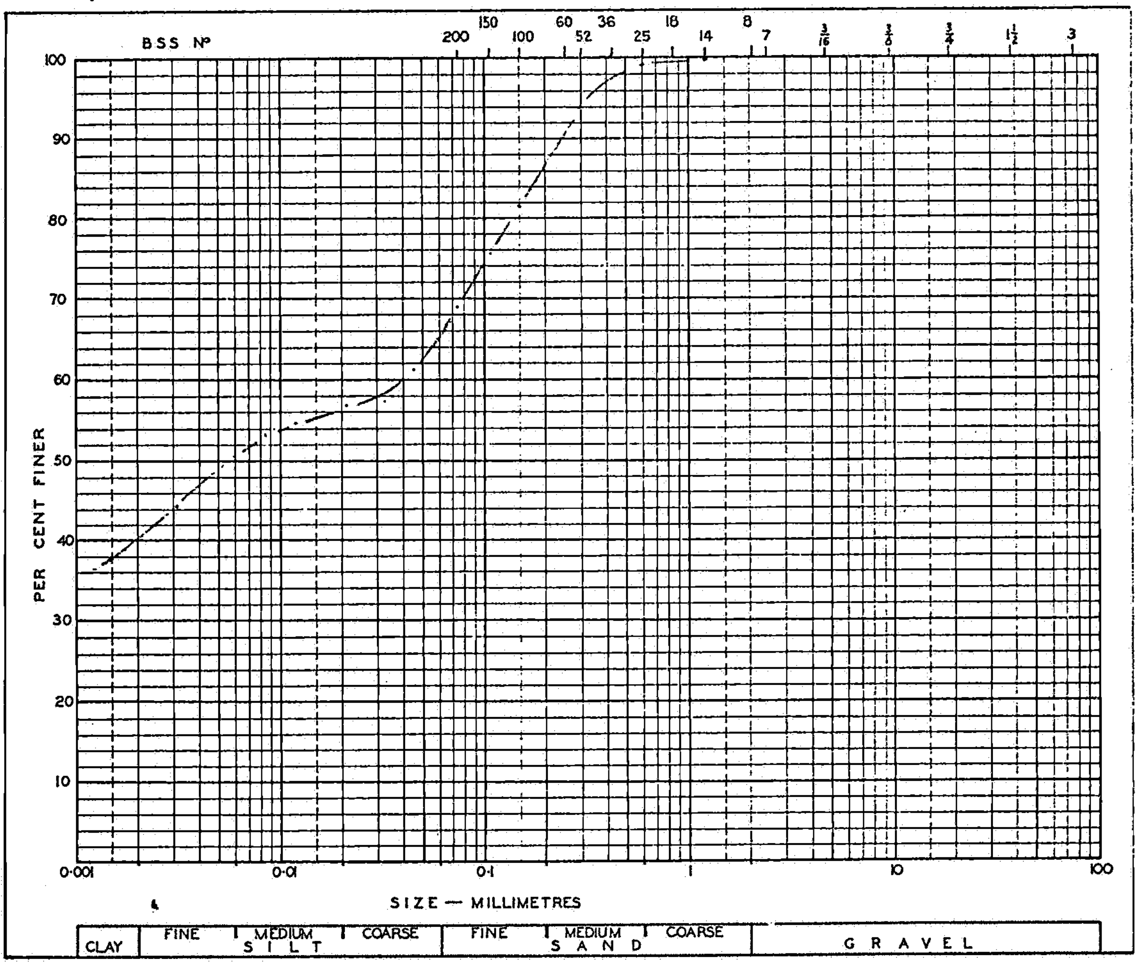
MAX. DRY DENSITY 109 lbs. cu ft

JOB	AUGUSTA SALT CO	SAMPLE No ML 139/1
LOCATION		
REFERENCE		
DATE	7. 8. 62	TRIAL HOLE 11 - 4L 6' - 18'
OPERATOR	DCH.	

F4

059

SAMPLE Nº



BSS & MIT CLASSIFICATIONS

JOB Augusta Salt Company	THE ENGINEERING AND WATER SUPPLY DEPARTMENT MECHANICAL ANALYSIS
LOCATION Port Augusta	
REFERENCE	
DATE 9.8.62	SAMPLE Nº ML 139/2 Trial hole No 11-5L Depth 18'-24'
OPERATOR G.C.	

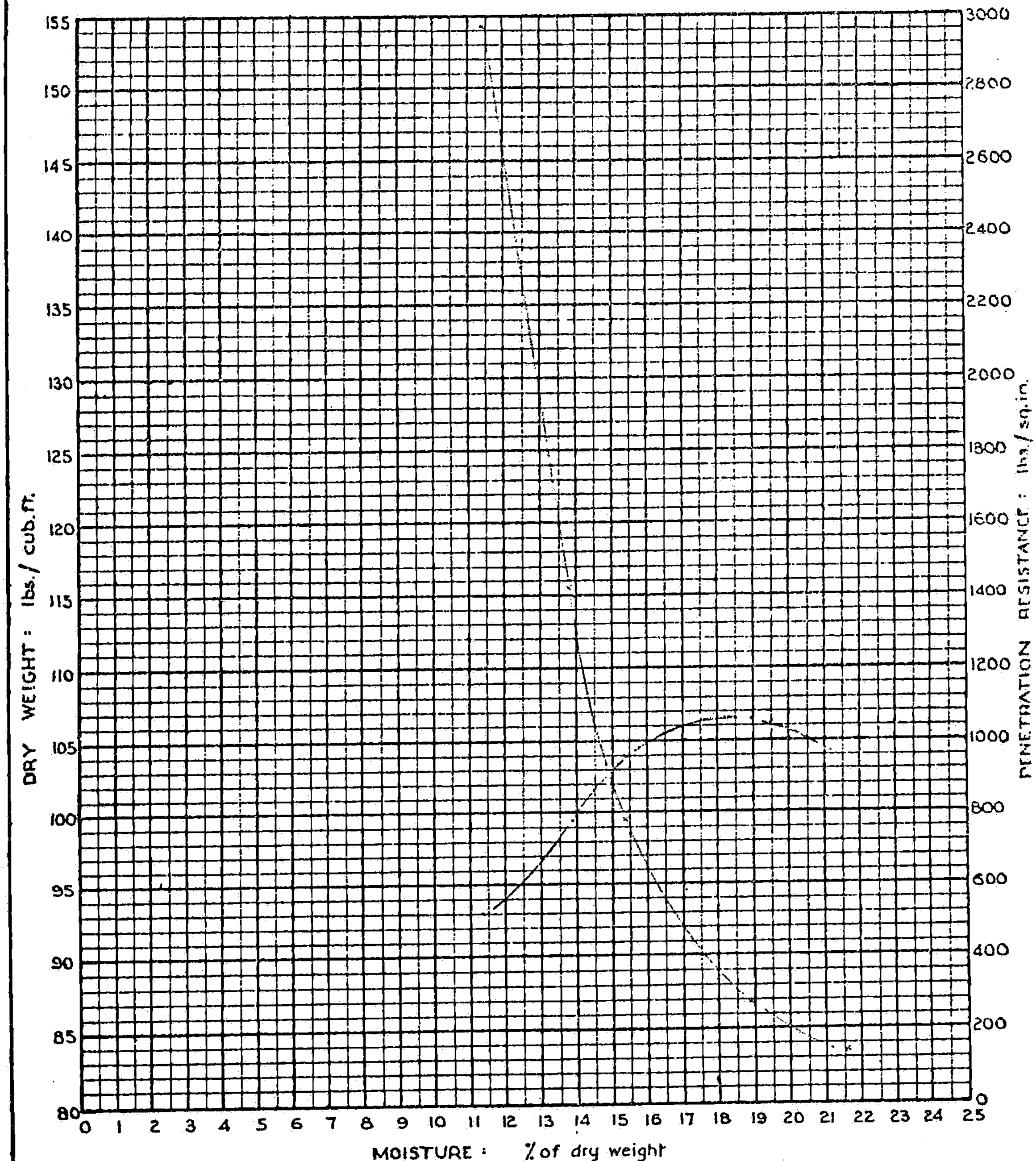
Specific gravity ________ Plasticity Index 35

Liquid limit 51 Shrinkage ratio 1.98

Plastic limit 16 Classification ________

Shrinkage limit 11.7

SAMPLE No. 060



DATA

SPECIFIC GRAVITY :

SAMPLE PASSING SIEVE No. : 3/16

COMPACTION :

Vol. sample : cub.ft. : 1/30

Blows per layer : 25

Layers : 3

Hammer wgt : lbs : 5 1/2

fall : ins : 12

dia : ins : 2

OMC - 18 %

MAX. DRY DENSITY 106.3 lbs/cu ft.

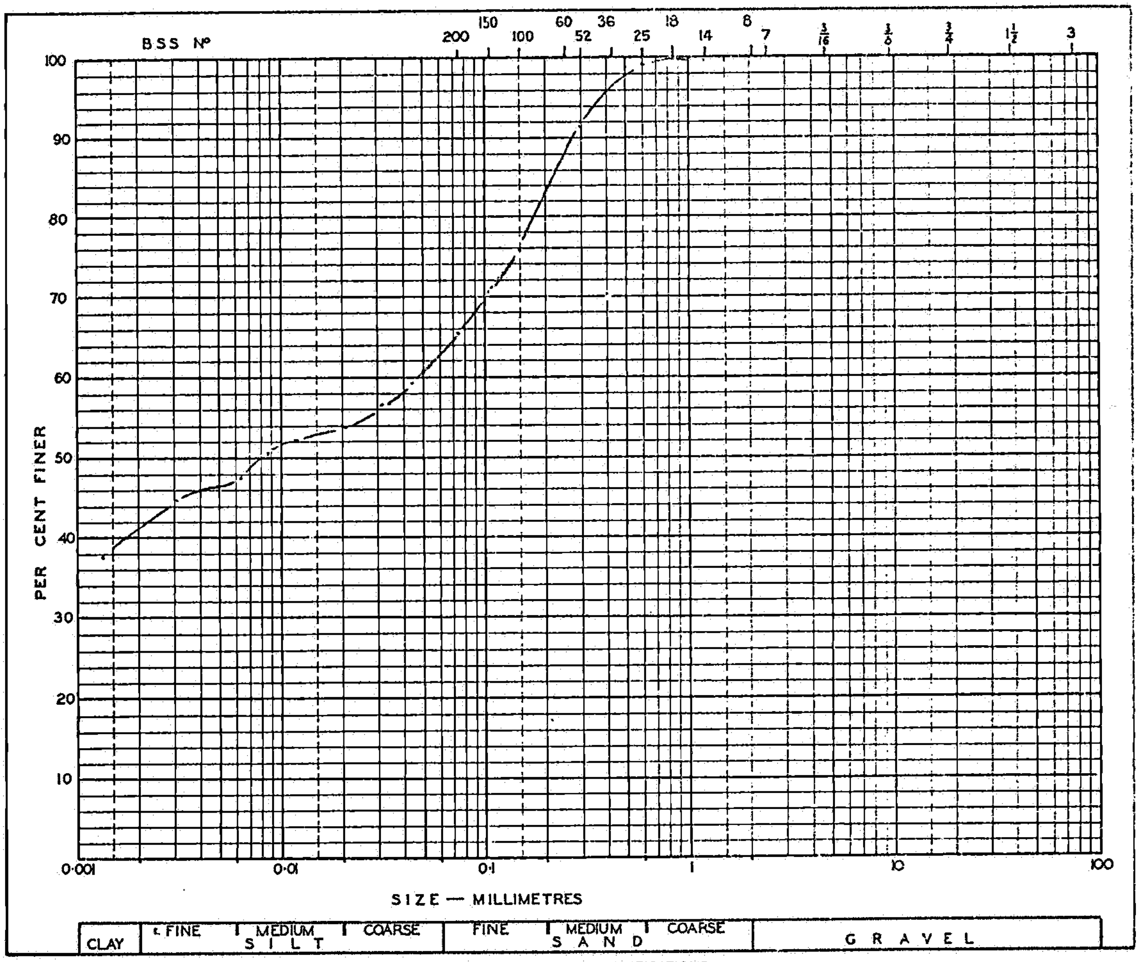
THE ENGINEERING AND WATER SUPPLY DEPARTMENT

PENETRATION RESISTANCE COMPACTION AND COMPLETE SATURATION CURVES

JOB AUGUSTA SALT CO	SAMPLE No. ML 139/2
LOCATION PORT AUGUSTA	
REFERENCE	TRIAL HOLE 11 - 5L
DATE 7.8 62	18' - 24'
OPERATOR DCM	

r4

SAMPLE No. 061



BSS & MIT CLASSIFICATIONS

JOB Augusta Salt Company	THE ENGINEERING AND WATER SUPPLY DEPARTMENT MECHANICAL ANALYSIS
LOCATION Port Augusta	
REFERENCE	
DATE 9. 8. 62	SAMPLE No. ML 139/3 Trial Hole No 11-6A Depth 2'-34'
OPERATOR G.C.	

Specific gravity ______

Liquid limit 38

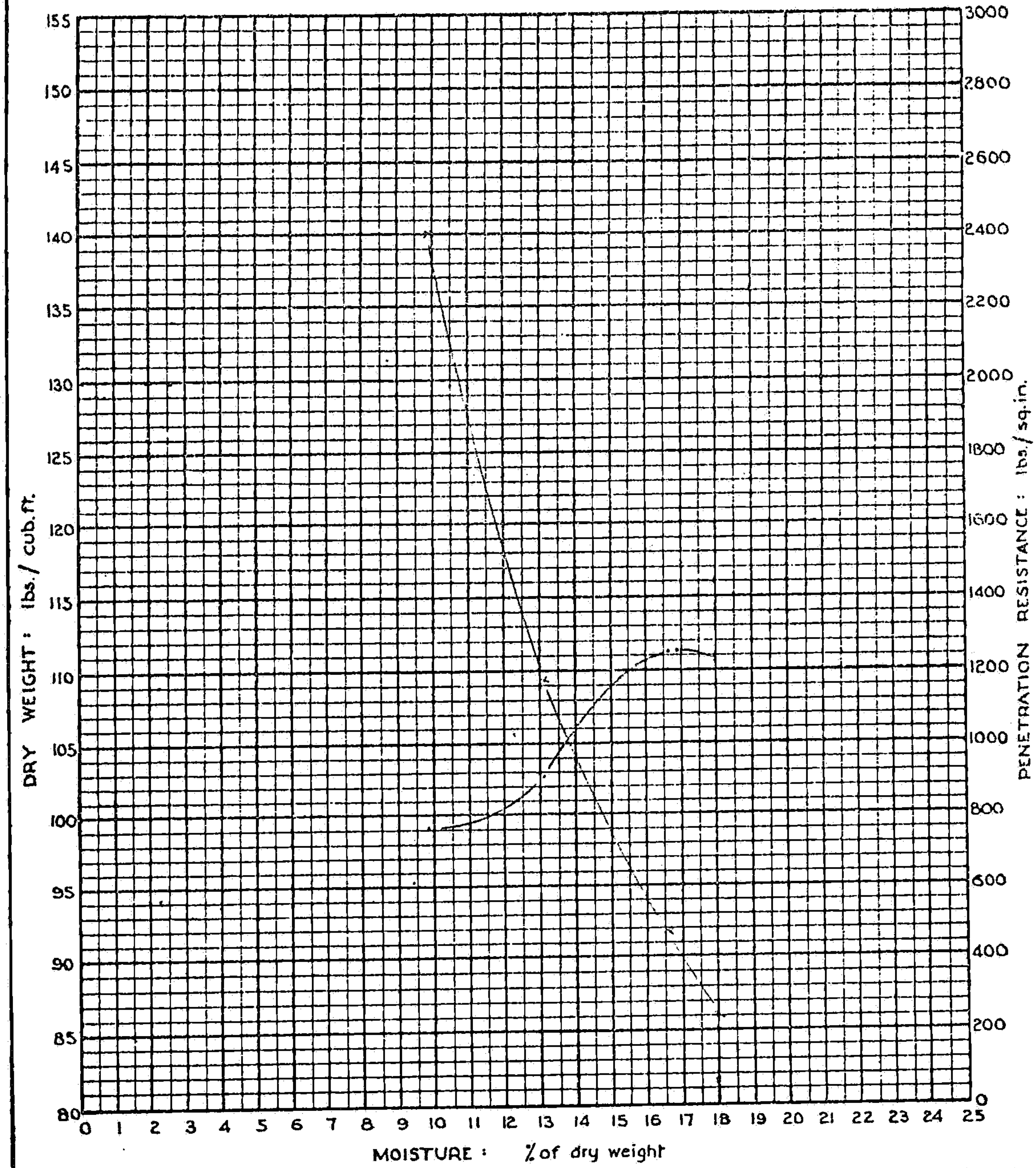
Plastic limit 13

Shrinkage limit 11.6

Plasticity index 25

Shrinkage ratio 1.94

Classification ______

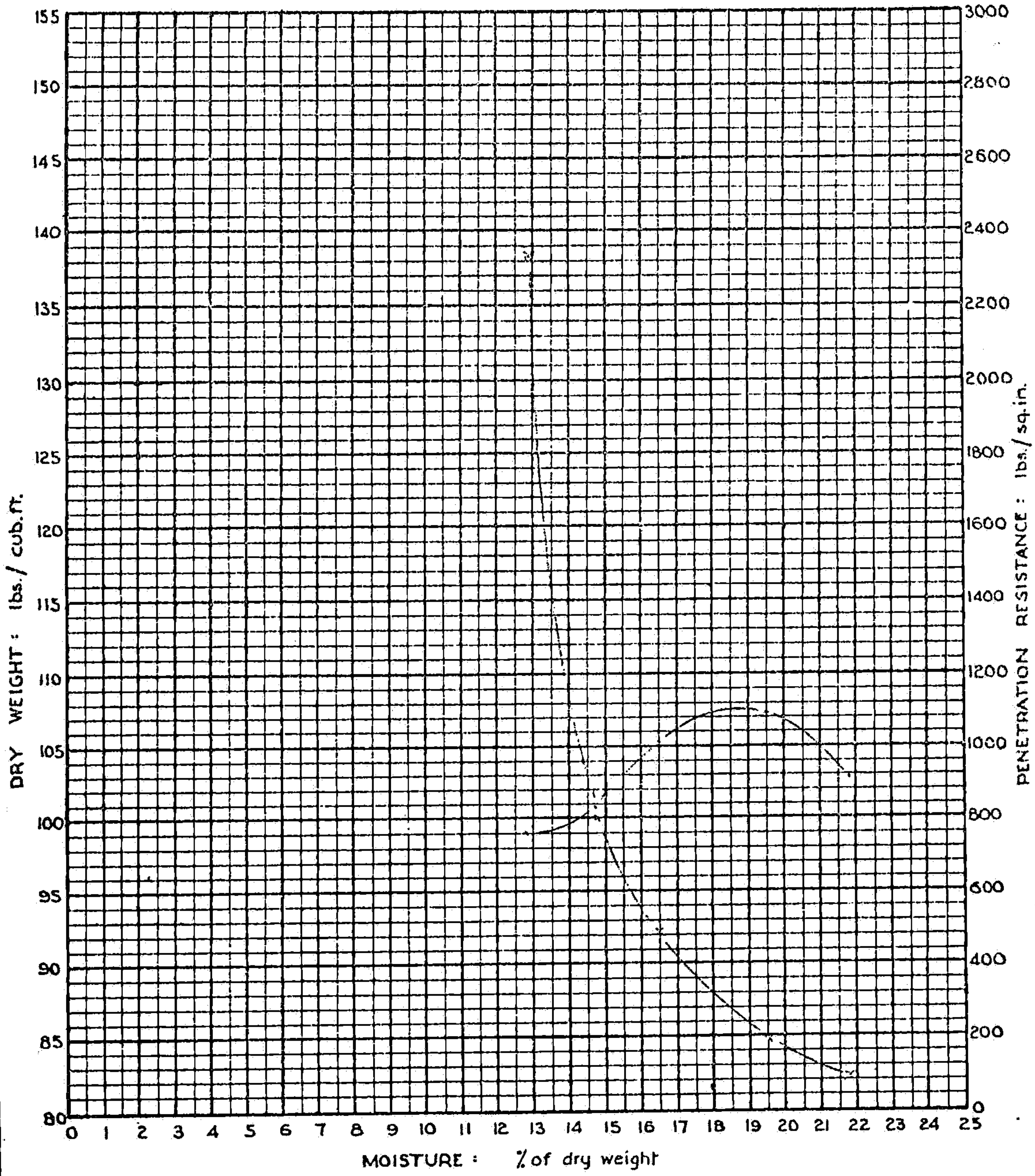


DATA	THE ENGINEERING AND WATER SUPPLY DEPARTMENT
SPECIFIC GRAVITY :	PENETRATION RESISTANCE COMPACTION AND COMPLETE SATURATION CURVES
SAMPLE PASSING SIEVE Nº : 3/16	
COMPACTION :	
Vol. sample : cub.ft. : 1/30	JOB AUGUSTA SALT CO
Blows per layer : 25	LOCATION
Layers : 3	REFERENCE
Hammer wgt : lbs : 5½	DATE 7. 8. 62
fall : ins : 12	OPERATOR D.C.M.
dia : ins : 2	SAMPLE Nº ML 139/3
OMC - 17 %	TRIAL HOLE 11 - 6A
MAX DRY DENSITY 111.5 lbs/cu ft	2' - 34'

Plastic limit 15 Classification

Shrinkage limit 12.3

SAMPLE No. 064



DATA

SPECIFIC GRAVITY :

SAMPLE PASSING SIEVE No. :

COMPACTION :

Vol. sample : cub.ft. :		1/30
Blows per layer :		25
Layers :		3
Hammer	wgt : lbs :	5½
	fall : ins :	12
	dia : ins :	2

OMC 18.5 %

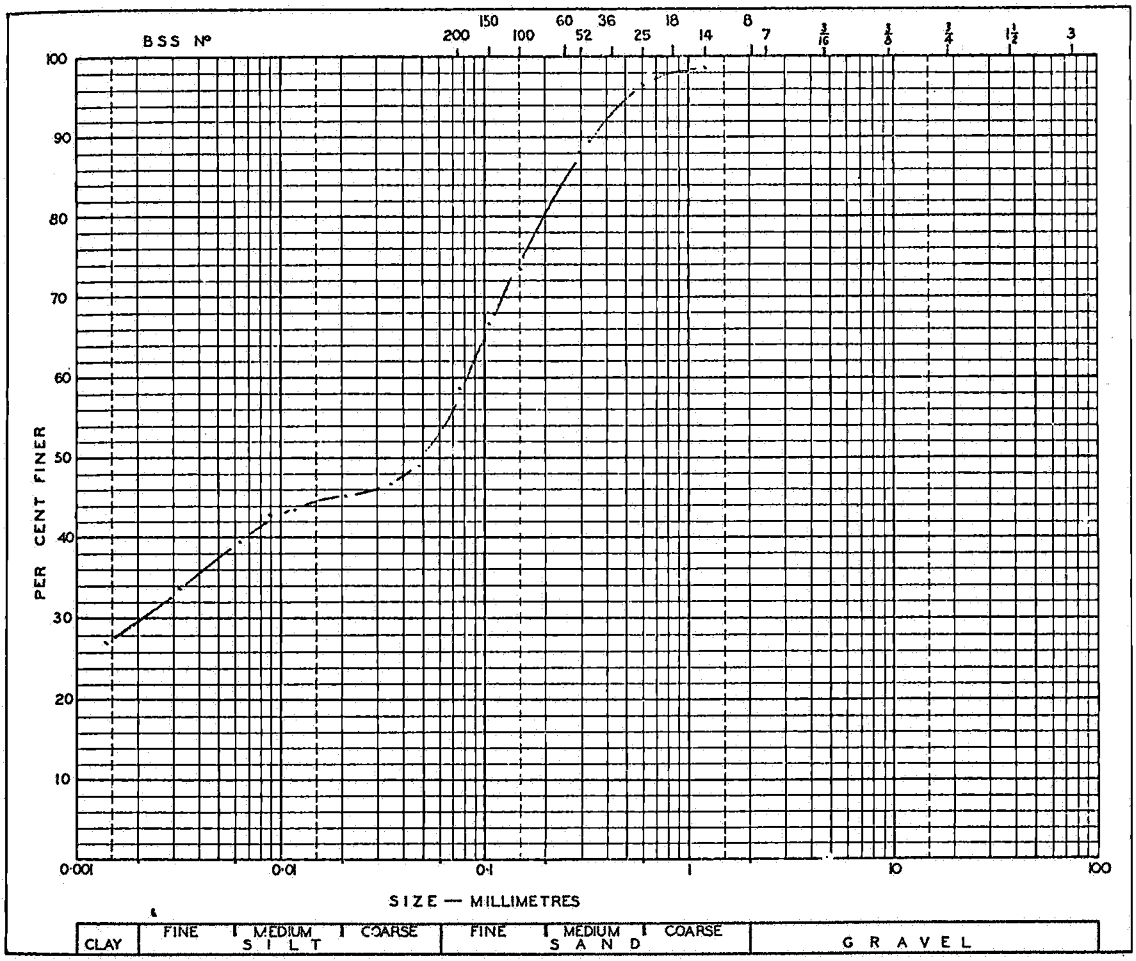
MAX. DRY DENSITY 107.6 lbs/cu ft

THE ENGINEERING AND WATER SUPPLY DEPARTMENT

PENETRATION RESISTANCE
COMPACTION
AND
COMPLETE SATURATION CURVES

JOB AUGUSTA SALT CO	SAMPLE No
LOCATION PORT AUGUSTA	ML 139/4
REFERENCE	
DATE 9.8.62	TRIAL HOLE 11 – 6G 0' – 24'
OPERATOR	

SAMPLE No. 1



BSS & MIT CLASSIFICATIONS

JOB Augusta Salt Company	THE ENGINEERING AND WATER SUPPLY DEPARTMENT
LOCATION Port Augusta	MECHANICAL ANALYSIS
REFERENCE	
DATE 9.8.62	SAMPLE No. ML 139/5
OPERATOR D.G.M.	TRIAL HOLE NO S 1 DEPTH 0' - 10'

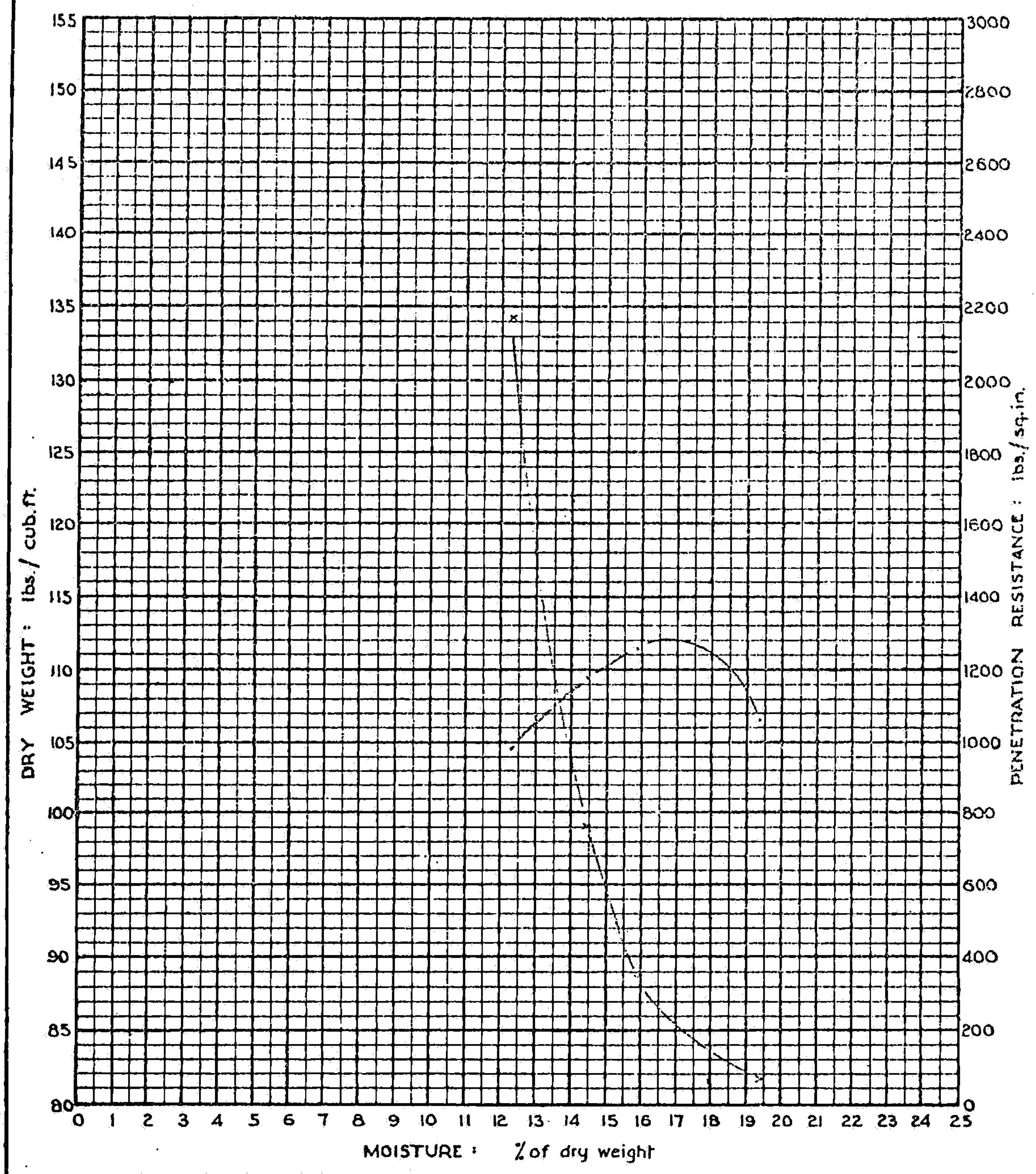
Specific gravity ________ Plasticity index 19

Liquid limit 35 Shrinkage ratio 1.88

Plastic limit 16 Classification ________

Shrinkage limit 14.2.

SAMPLE No. 066



DATA

SPECIFIC GRAVITY :

SAMPLE PASSING SIEVE No. : 3/4

COMPACTION :

Vol. sample : cub.ft. :		1/30
Blows per layer :		25
Layers :		3
Hammer	wgt : lbs :	5½
	fall : ins :	12
	dia : ins :	2

OMC - 16.5%
MAX. DRY DENSITY 112 lbs/cu ft

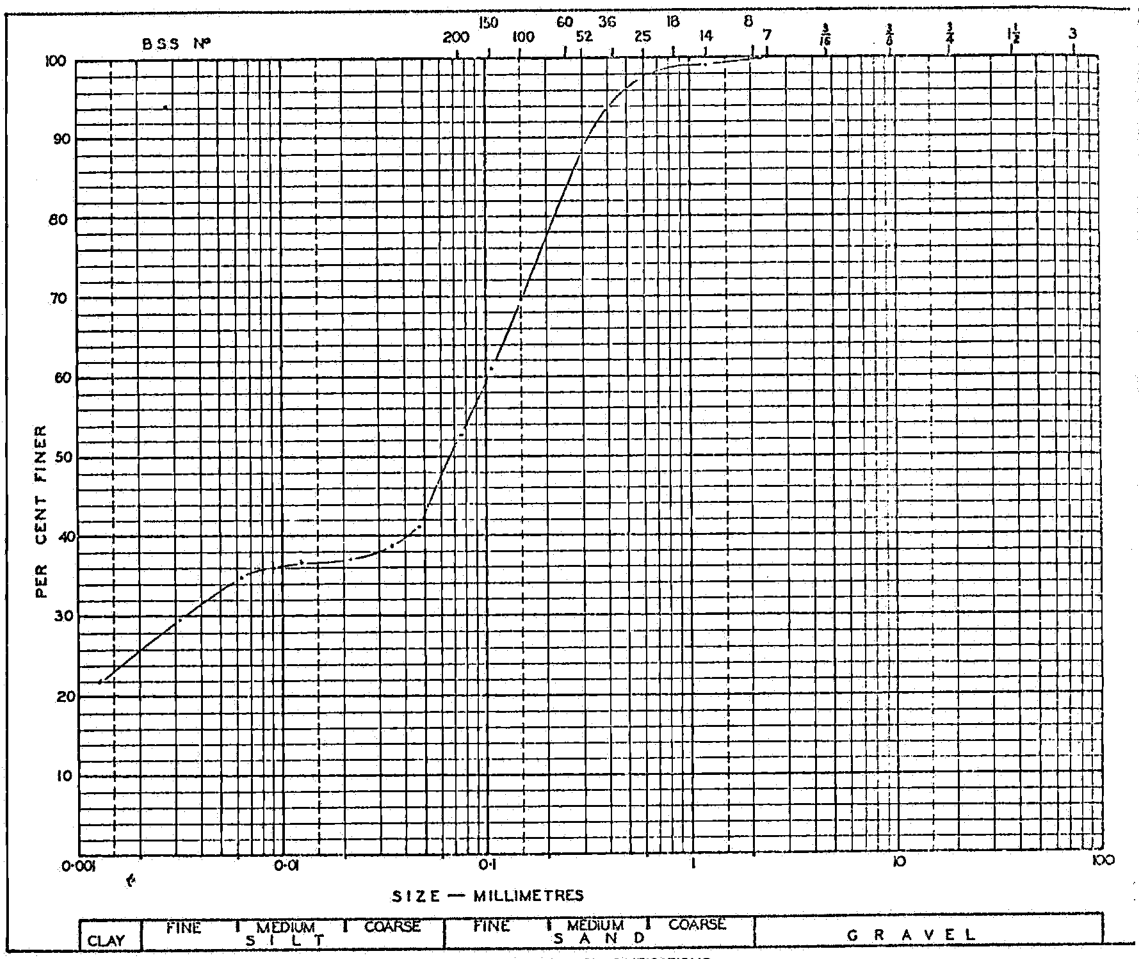
THE ENGINEERING AND WATER SUPPLY DEPARTMENT

PENETRATION RESISTANCE
COMPACTION
AND
COMPLETE SATURATION CURVES

JOB AUGUSTA SALT CO	SAMPLE No.
LOCATION PORT AUGUSTA	ML 139/5
REFERENCE	TRIAL HOLE.
DATE 9.8.62	S1
OPERATOR D.G.M.	0' - 10'

F4

SAMPLE Nº 067



BSS & MIT CLASSIFICATIONS

JOB Augusta Salt Company	THE ENGINEERING AND WATER SUPPLY DEPARTMENT
LOCATION Port Augusta.	MECHANICAL ANALYSIS
REFERENCE	
DATE 23·8·62.	SAMPLE Nº ML 142/2 Depth. 1'9"-2'2"
OPERATOR G.C.	

Specific gravity..........

Liquid limit 31·4

Plastic limit 13·8

Shrinkage limit 14·7

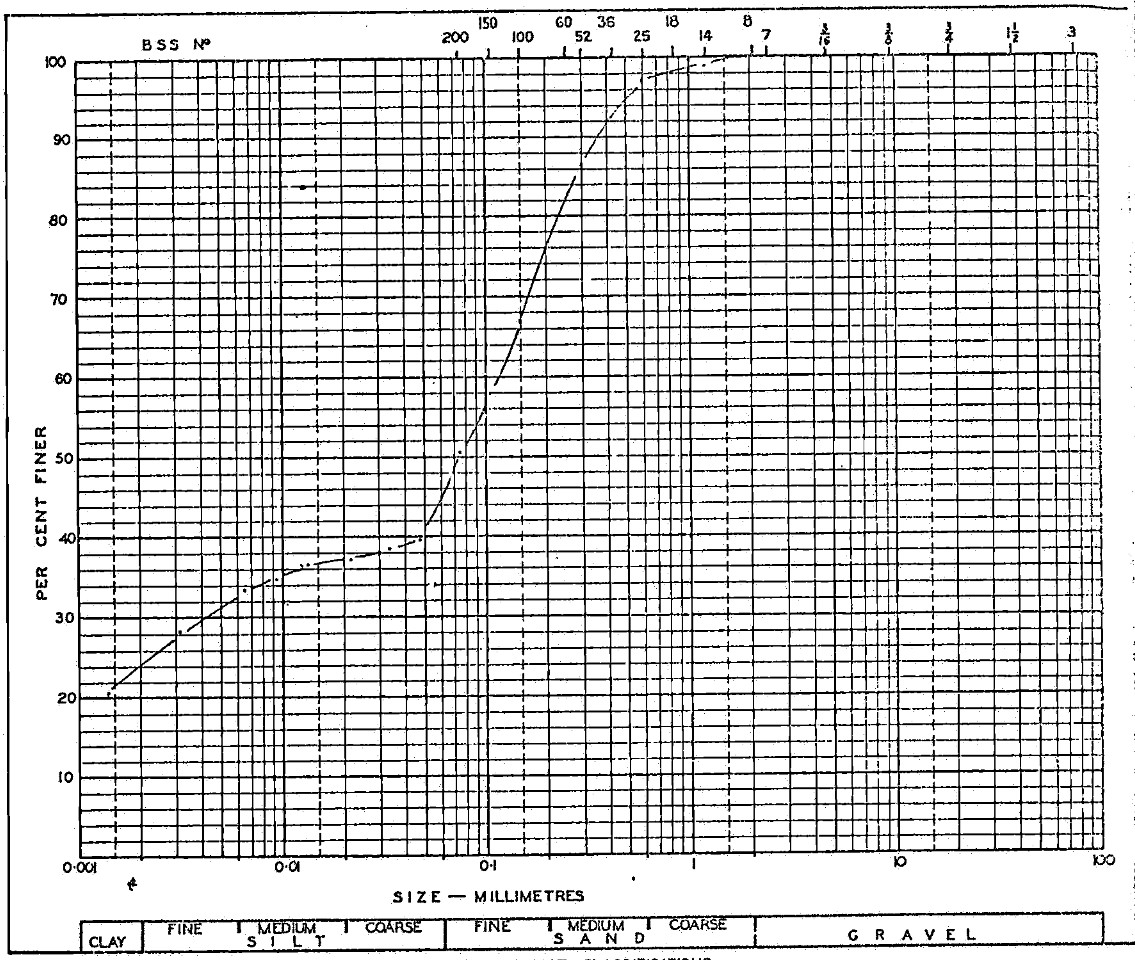
Plasticity index 17·6

Shrinkage ratio 1·84

Classification ....

Lime Content. 19%.

SAMPLE No. 068



BSS & MIT CLASSIFICATIONS

JOB Augusta Salt Company.	THE ENGINEERING AND WATER SUPPLY DEPARTMENT MECHANICAL ANALYSIS
LOCATION Port Augusta.	
REFERENCE	
DATE 23·8·62	SAMPLE No. ML 142/6 Depth. 6'10". - 7'3".
OPERATOR G.C.	

Specific gravity .... Plasticity index 16·7

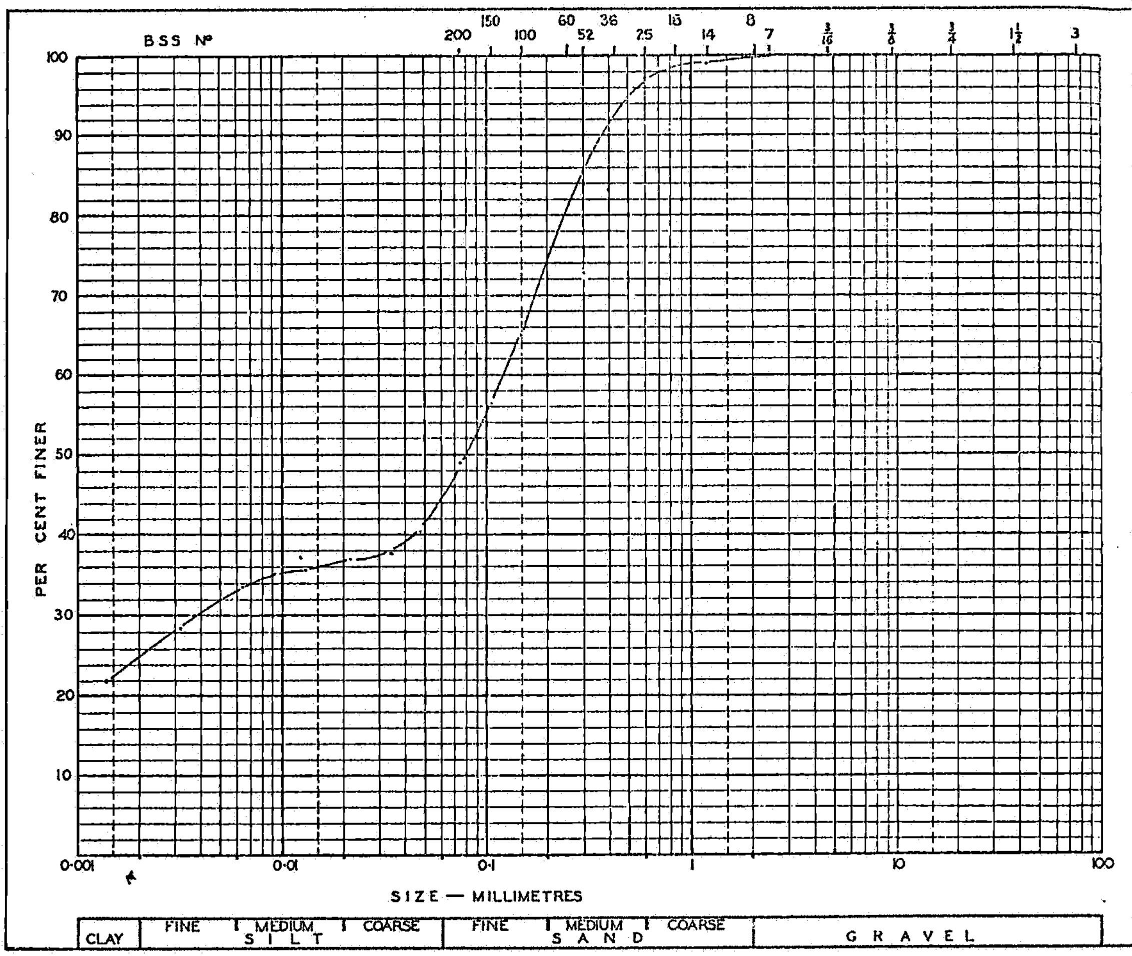
Liquid limit 30·7 Shrinkage ratio 1·83

Plastic limit 14·0 Classification ....

Shrinkage limit 14·5 Lime Content 17%

F4

SAMPLE No. 069



BSS & MIT CLASSIFICATIONS

JOB Augusta Salt Company	THE ENGINEERING AND WATER SUPPLY DEPARTMENT
LOCATION Port Augusta.	
REFERENCE	MECHANICAL ANALYSIS
DATE 23·8·62.	SAMPLE No. ML 142/8 Depth. 8'9½"–9'2½"
OPERATOR G.C.	

Specific gravity ....

Liquid limit 30·0

Plastic limit 13·4

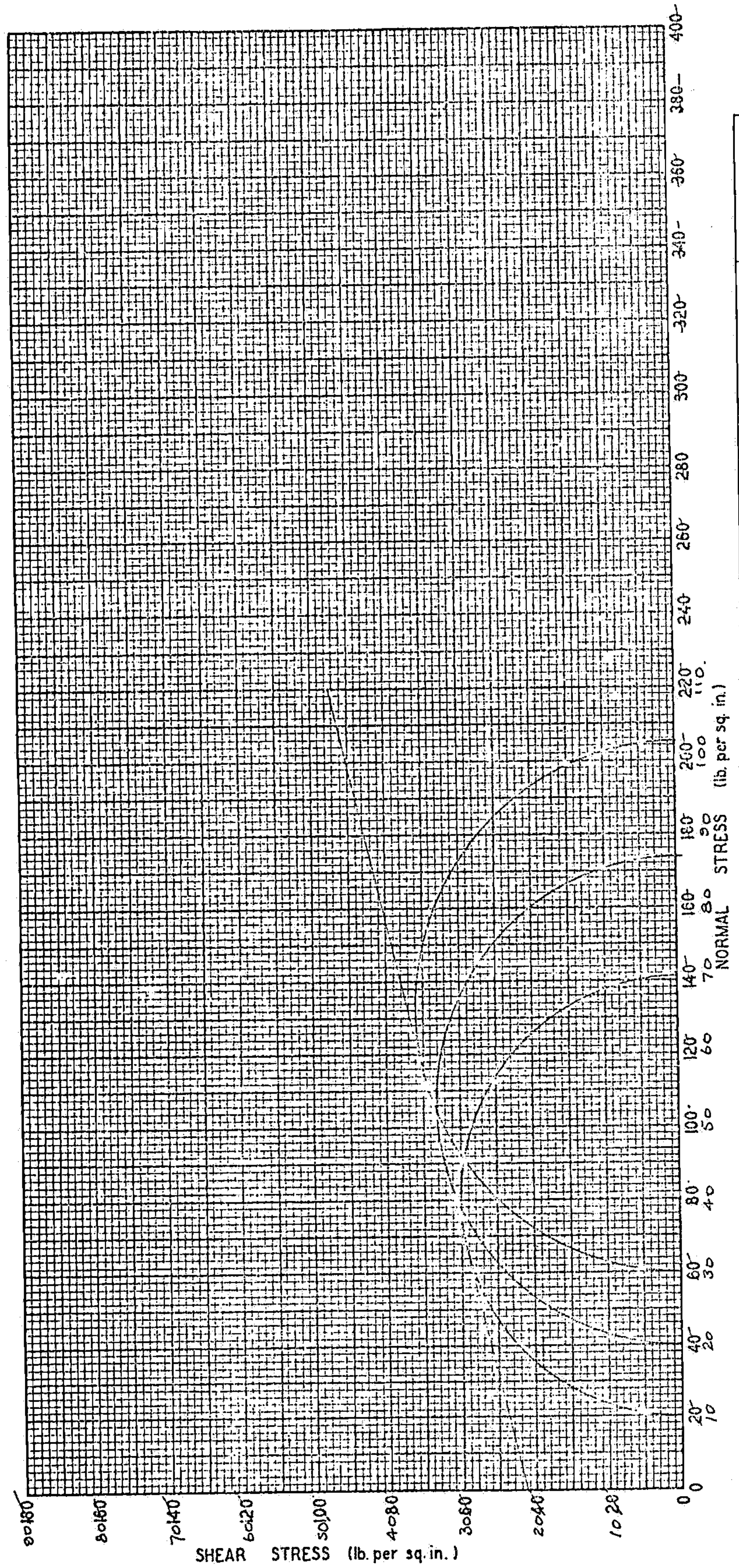
Shrinkage limit 15·4

Plasticity index 16·6

Shrinkage ratio 1·81

Classification ....

Lime Content 19%



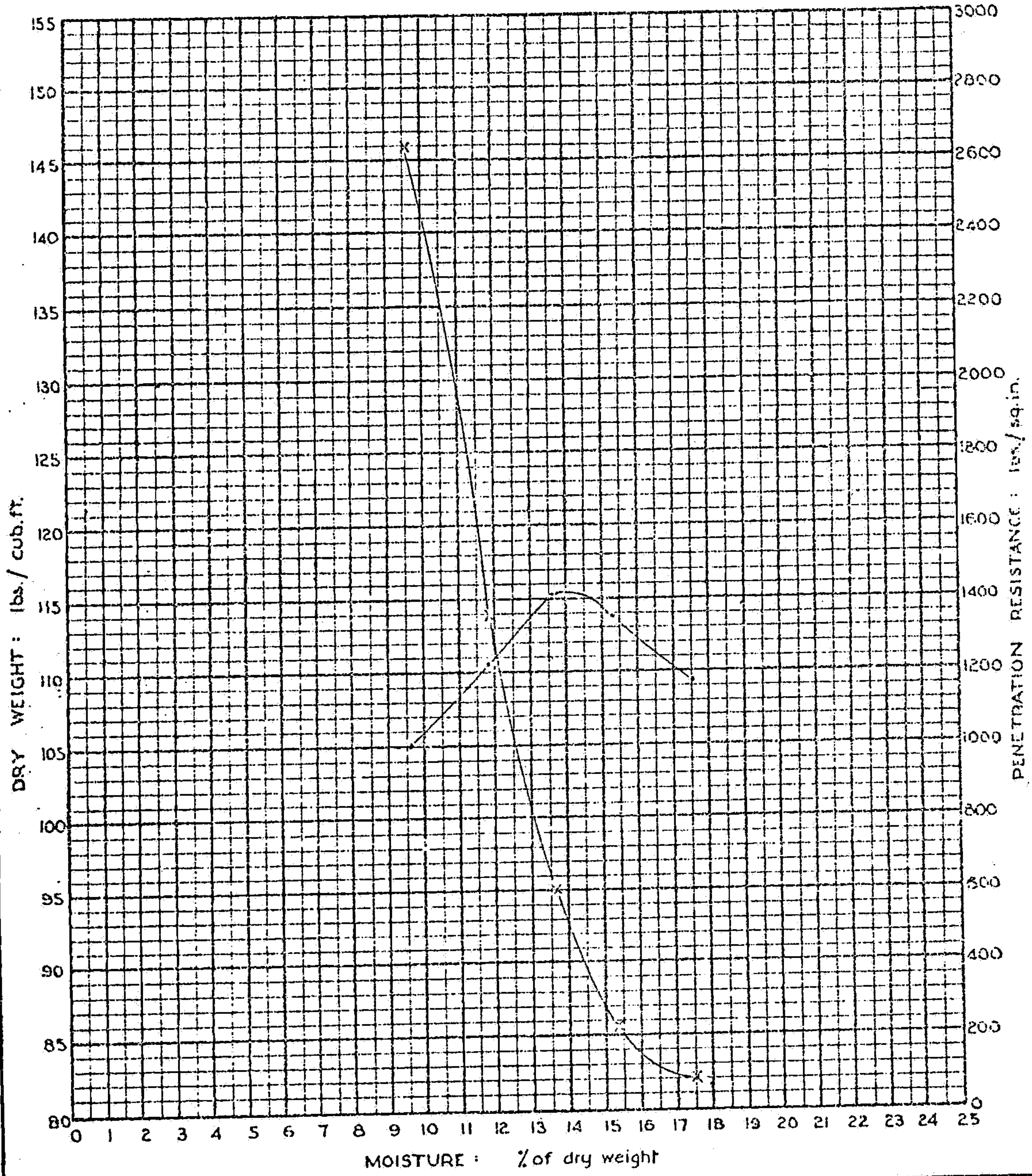
Symbol and Number										
Desired dry density (p.c.f.)										
Placed " "	116.6	116.6	116.6							
Desired moisture content (% dry wt.)										
Placed " "	13.6	13.6	13.6							
Applied Lateral Pressure (p.s.i.) σ_{III}	10	20	30							
Effective " " $\bar{\sigma}_{III}$										
Maximum pore pressure " u										
Maximum Effective Princ. Stress (p.s.i.) $\bar{\sigma}_I$	70.4	87.0	102.4							
Radius of circle $\frac{1}{2}(\bar{\sigma}_I - \bar{\sigma}_{III})$	30.2	33.5	36.2							
Centre " " $\frac{1}{2}(\bar{\sigma}_I + \bar{\sigma}_{III})$	[illegible]	[illegible]	[illegible]							

Tan. ϕ 0.239 ∴ ϕ = 13°26'

C 21.3 lb/sq. in.

Job	AUGUSTA SALT CO.	THE ENGINEERING AND WATER SUPPLY DEPARTMENT
Location	PT. AUGUSTA	TRIAXIAL COMPRESSION (UNDRAINED) TEST MOHR DIAGRAMS
Reference		
Date	22 - 8 - '62	
[illegible]	[illegible]	SAMPLE No. ML 142 1-9 (Mixture)

SAMPLE No. 071



DATA

SPECIFIC GRAVITY :

SAMPLE PASSING SIEVE N°: 3/16"

COMPACTION :

Vol. sample : cub.ft. :		1/30
Blows per layer :		25
Layers :		3
Hammer	wgt : lbs :	5½
	fall : ins :	12
	dia : ins :	2

O.M.C. 14.0 %

Max. D.D. 115.3 lbs. / c.ft.

THE ENGINEERING AND WATER SUPPLY DEPARTMENT

PENETRATION RESISTANCE
COMPACTION
AND
COMPLETE SATURATION CURVES

JOB AUGUSTA SALT CO.	SAMPLE N°
LOCATION PT. AUGUSTA.	
REFERENCE	M.L. 142/1-3 (Mixture)
DATE 23 - 8 - '62	
OPERATOR [illegible]	

ENV 1140.

DELHI AUSTRALIAN PETROLEUM LTD.

32 GRENFELL STREET, ADELAIDE
SOUTH AUSTRALIA 5000

Address all correspondence to:
THE RESIDENT MANAGER

November 7, 1969

RECEIVED
7 - NOV 1969
DEPT. OF MINES
REGISTRY

The Minister of Mines
C/- The Director
Department of Mines
169 Rundle Street
ADELAIDE S.A. 5000

Dear Sir:

re: Application for Special Mining Lease
Point Paterson and Port Pirie Salt Areas

In accordance with discussions at the meeting held in Adelaide on Thursday, October 30, 1969 attended by the Honourable R.C. DeGaris, Minister of Mines, Mr. L.W. Parkin, Deputy Director of Mines, Mr. F.A. Close, Chairman of Vam Limited, Dr. W.D. Ackland-Horman, Director of Vam Limited, and Mr. Charles T. Easley, Resident Manager of Delhi Australian Petroleum Ltd., Delhi Australian Petroleum Ltd. of 32 Grenfell Street, Adelaide, under the provision of Section 62 and 62 (a) of the Mining Act, 1930-1958, hereby applies for a Special Mining Lease covering approximately 932 square miles within the boundaries described on Attachment "A".

A Plan of the area applied to be held under the Special Mining Lease is shown on Attachment "B".

1. Ownership

Delhi Australian Petroleum Ltd. will hold the Special Mining Lease for and on behalf of Delhi Australian Petroleum Ltd., Vam Limited and Hardman Chemicals Pty. Ltd. who will have ownership in the proportions of 45%, 45% and 10% respectively.

Vam Limited is in the process of officially registering in South Australia to participate positively in this and several other ventures. In the last twelve months, Vam has raised and financed through and for its subsidiary, Vamgas N. L., $11,700,000 all for South Australian gas development and oil and gas exploration. In so doing, Vam stated that this was intentionally done to secure a foothold in the "future" of South Australia, namely a stake in the industrial development which would be expected to flow from the utilisation of gas with other new materials. The recent reaction by Vam to a foreign takeover bid for McDonald Industries, demonstrates their ability to find funds. Vam thwarted control of McDonald in two days and financed the necessary $4,000,000 one day later. During the last twelve months the Vam Group has raised $24,000,000 and has a further $9,000,000 to come in options over the next ten months. Vam Limited has fixed assets in excess of $3,000,000 and apart from numerous private companies, holds listed shares with market value in excess of $30,000,000.

Hardman Chemicals Pty. Ltd. has been manufacturing chemicals for nearly twentyfive years and at present operates from sites at Marrickville and Seven Hills in the State of New South Wales. The Company is now probably the largest independent all Australian manufacturer. The Managing Director, Mr. Alexander Boden, has recently made an extensive overseas tour during which he examined salt installations and investigated markets and business relations in respect of salt. Hardman Chemicals Pty. Ltd. are particularly interested in handling bitterns and this would comprise part of their contribution to the joint venture. Handling of bitterns would require a source of lime and a search for high grade lime would form part of the initial study. ? Coffin Bay

Delhi Australian Petroleum Ltd. is well known to the South Australian Mines Department as a result of over ten years activity in oil and gas exploration in this State. Major gas discoveries at Gidgealpa, Moomba, Daralingie and Toolachee have resulted from their efforts. Gas from the Gidgealpa-Moomba fields is expected to begin to be sold in Adelaide and environs during November, 1969. Delhi Australian Petroleum Ltd. is considering forming an associated mineral company with substantial Australian equity participation and if this is accomplished, the title to the Special Mining Lease will be transferred to this Company, subject to approval of the Honourable the Minister of Mines.

2. Work Programme and Expenditure

The applicant proposes during the two year period to undertake a work and study programme to determine the economic feasibility of developing a complex on the areas covered by the Special Mining Lease capable on completion of the initial stage of development of producing one million tons of washed salt per annum. Further studies will be undertaken to determine whether the complex is capable of development to produce three million tons of salt per annum. If the feasibility studies indicate that the project is viable and economic, it is proposed to set up solar evaporating areas at both Point Paterson and Port Pirie. The programme envisages pumping high density brine from the Port Pirie area to the Point Paterson area into established crystaliser ponds, where the salt would be precipitated during the summer months of September through April and harvested during the winter months of May through August.

In consideration of the Government granting the two year Special Mining Lease, it is proposed to under-
(1) take a programme involving a complete aerial photography survey of both areas together with appropriate ground surveys. It is possible that it will be found to be more efficient and less costly
or to undertake the full survey by the ground method on an approximately 900 foot grid. After completion of this survey it is proposed to undertake
(2) engineering ground studies to sufficiently evaluate

the nature of the terrain for salt making purposes to permit a decision to be made as to the suitability of the area and the capital cost of development. It is then proposed to undertake a
(3.) mining, transport and finance feasibility study which would involve marketing prospects and the possibility of obtaining long term contracts for the sale of salt.

Anticipated Expenditure

Mapping	$A	35,000
Soil testing		10,000
Test ponds		25,000
Engineering and feasibility studies		25,000
Contingencies and Operating Expense		30,000
Total	$A	125,000

3. Markets

It is proposed that the initial production of one million tons per year will be for the export market as will be the initial production of three million tons from the second stage development if it is proceeded with. Whilst the initial production from the second stage will be bound for the export market, as the opportunity arises for development of an industrial complex based on locally mined and produced ores and products, full advantage will be taken of this situation as far as the supply of salt from the licence areas is concerned.

4. Loading Terminal

As part of the project it will be necessary to establish a loading terminal capable of accepting 60,000 to 100,000 DWT ships, together with a conveyor system from a land based stock pile having a loading rate of approximately 1,000 tons per hour. It is estimated that this installation will cost three million dollars to three and one-half million dollars. It would be expected that the Government of South Australia would favourably consider the installation of the loading terminal and conveyor system based either on the Government procuring the funds initially and charging the producers a certain cost per unit for purposes of repayment of their investment, or by Vam Limited finding the funds for such facilities with the South Australian Government acting as guarantor.

5. Cost Estimates

Based on initial assumptions which must be proven by the carrying out of further programmes, it is felt that the project may be undertaken viably if a market price of approximately $4.00 per long ton FOB Point Paterson is obtained. This is based on

???

an estimate of capital and operating costs of approximately $2.00 per ton ready for transport. It is estimated that in order to establish a facility capable of producing one million long tons initially, the capital unit outlay for construction will be approximately $5.00 per ton, not including land acquisition, employee housing or ship loading facilities. The cost of $2.00 per ton of washed salt is based on 50 cents per ton for depreciation and amortization of plant and $1.50 per ton for cost of production, harvesting, transportation, washing and stockpiling.

6. Timetable of Development

Should the project prove to be viable as a result of the feasibility studies to be undertaken, it is estimated that it will take at least one year for construction of facilities and four years thereafter for operations to bring about a maturity of the brine, for the laying down of salt floors, and for the harvesting of the first crop of salt. Therefore, it will be approximately five years from commencement of the project before the first shipment could be realized. Full production and shipping may be expected thereafter.

7. Granting of Production Leases and Royalty

We would propose that should the feasibility study prove favourable and the project decided to be proceeded with, that upon the expiration of this Special Mining Lease, sufficient twentyone year

Production Leases to cover the area of interest would be granted, together with rights of renewal for additional periods of twentyone years. It would be expected that a royalty of approximately 2-1/2 percent on net income would be due and payable to the State from sale of salt produced from the area. Net income being that amount of money left after deducting the costs of capital, production, treatment and transport of the material from the selling price obtained from a bona fide purchaser.

8. Overseas Partner

Whilst no participant with an overseas market is included as a partner applicant for the Special Mining Lease at this time, it is anticipated that during the second year as part of the market study, consideration will be given to the advisability of offering a large potential overseas customer an equity participation in the project. It is felt that at such time sufficient details will be available to make reasonable conclusions as to the economic viability of the project and the potential overseas participant could then be approached on a sounder basis.

9. Special Consultants Report

It is believed that this salt winning situation is the best in South Australia and that it is one of the safest in Australia. It is further recognised that this resource may provide a base for a permanent industrial complex of the utmost importance to South Australia and to Australia which, with its great bauxite reserves and alumina projections, is to become a great user of caustic soda.

Additionally using gypsum from the environs of Lake Torrens and natural gas, it is possible that the caustic soda production may be combined with by product sulphur and calcium chloride.

Calcium chloride is likely to be in large demand in Australia as a chloride reductant in the winning of nickel and cobalt from laterite ores by process akin to the Torno Process of Anglo-American, International Nickel and others. It is worthy of note that Vam Limited has allocated $200,000 to research on this process by university and other research organisations in Australia.

It is considered that it is wholly desirable not to pre-empt the salt production irrevocably for overseas sales, but to generate a stable salt facility based on early overseas markets through tied associations of Vam Limited and Hardman Chemicals Pty. Ltd. and thence base a major grassroot and lasting South Australian industrial facility.

It is proposed to retain Messrs. A.Z. Richards, Jnr. and M.H. Montgomery, Engineering Consultants of the firm of Caldwell, Richards and Sorensen, Inc. of Salt Lake City, Utah, to the joint venture and Messrs. McDonald Industries Limited as Consultants and co-ordinating contractors for the salt and port facility.

An initial survey was carried out by Messrs. Richards and Montgomery for our account in October, 1969 and a copy of this report is attached and made part of this application.

10. Assistance of South Australian Mines Department

We would like to express appreciation and compliment the ability of South Australian Mines Department personnel who have rendered willing and competent assistance in our work on this project to date.

We would indeed appreciate your favourable consideration of our application. We are prepared to answer any questions which might arise as a result of our proposal and furnish further information or clarification as requested.

Yours very truly,
DELHI AUSTRALIAN PETROLEUM LTD.

Charles T Easley

By Charles T. Easley
Resident Manager

cc: Vam Limited
Hardman Chemicals

CTE:bi

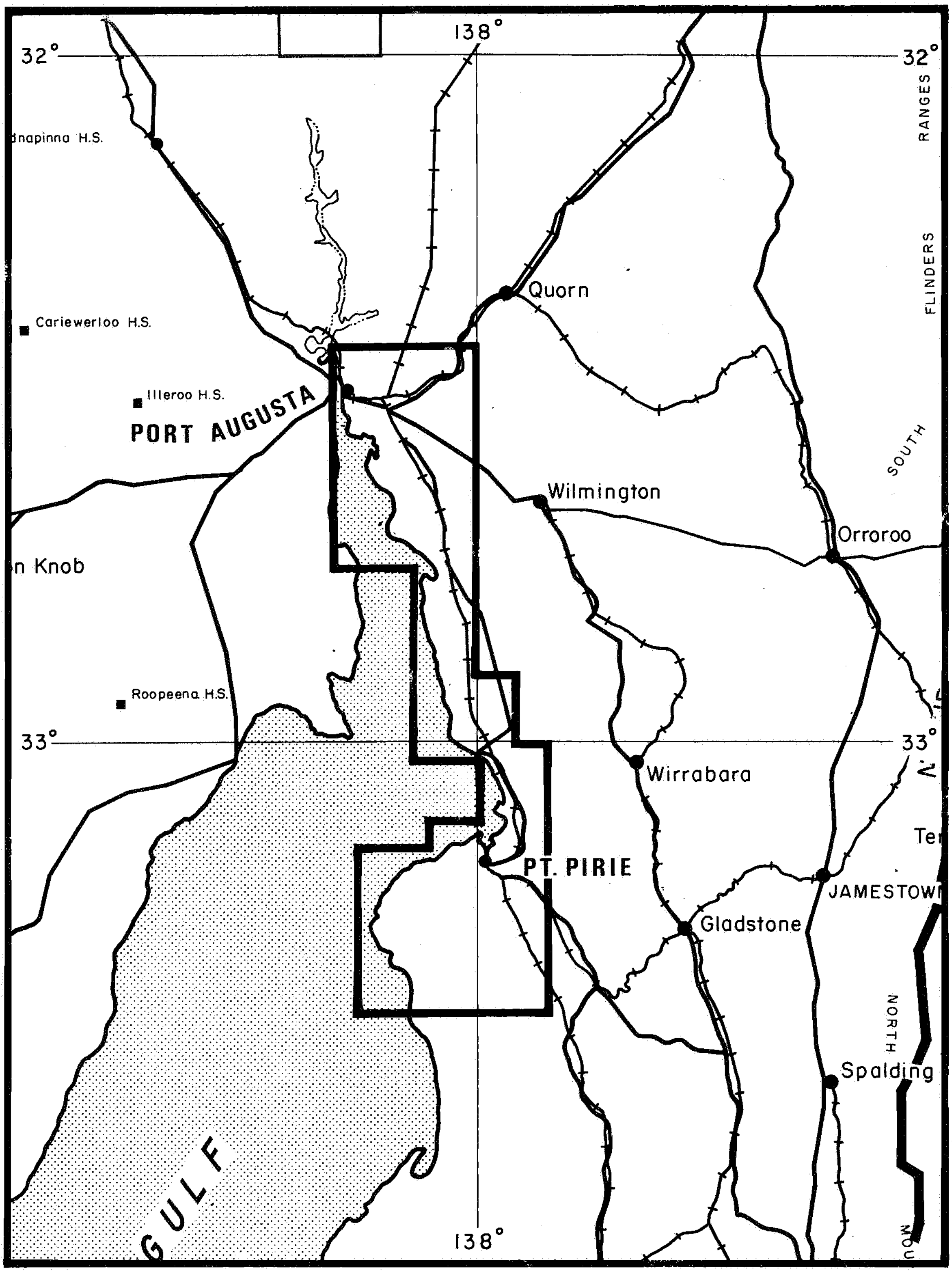
Attachment "A"

SPECIAL MINING LEASE

AREA: 932.0 Square Miles

SCHEDULE:

Beginning at a point being 138° 00' East Longitude and 32° 25' South Latitude, thence South to 138° 00' East Longitude and 32° 54' South Latitude, thence East to 138° 04' East Longitude and 32° 54' South Latitude, thence South to 138° 04' East Longitude and 33° 00' South Latitude, thence East to 138° 07' East Longitude and 33° 00' South Latitude, thence South to 138° 07' East Longitude and 33° 25' South Latitude, thence West to 137° 47' East Longitude and 33° 25' South Latitude, thence North to 137° 47' East Longitude and 33° 09' South Latitude, thence East to 137° 54' East Longitude and 33° 09' South Latitude, thence North to 137° 54' East Longitude and 33° 07' South Latitude, thence East to 138° 00' East Longitude and 33° 07' South Latitude, thence North to 138° 00' East Longitude and 33° 02' South Latitude, thence West to 137° 53' East Longitude and 33° 02' South Latitude, thence North to 137° 53' East Longitude and 32° 45' South Latitude, thence West to 137° 45' East Longitude and 32° 45' South Latitude, thence North to 137° 45' East Longitude and 32° 25' South Latitude, thence East to 138° 00' East Longitude and 32° 25' South Latitude, the point of origin.



DELHI AUSTRALIAN PETROLEUM LTD.

POINT PATERSON SALT

APPLICATION FOR SPECIAL MINING LEASE

NOVEMBER 1969 SCALE 1 : 1,000,000

ENV 1140

072

R E P O R T

ON THE

PRELIMINARY EXAMINATION OF LANDS

BETWEEN POINT PATERSON AND MT. GULLETT

NEAR

PORT AGUSTA, IN SOUTH AUSTRALIA

FOR THE PURPOSE OF DETERMINING

THE PRACTICABILITY

OF USING THESE LANDS

FOR LARGE SCALE SOLAR SALT PRODUCTION

WITH THE POSSIBILITY

OF LOCATING A BULK SALT LOADING AND SHIPPING FACILITY

NEAR RED CLIFF POINT

OCTOBER, 1969

CALDWELL, RICHARDS & SORENSEN, INC.,
Consulting Civil Engineers
118 First Avenue, Salt Lake City, Utah

INDEX

FORWARD

Through a personal contact of Mr. Alexander Boden, Chairman and Managing Director of Hardman Chemicals Pty., Ltd., of Merrickville, New South Wales, Australia, our firm was engaged by Mr. Charles Easley, of Delhi Australian Petroleum Ltd., Adelaide, South Australia, and by Mr. Frank A. Close, of VAM Ltd., Sydney, Australia, to visit the Spencer Gulf area of South Australia. The purpose of this visit was to examine the mud flats and natural tidal basin in the vicinity of Point Paterson and to give professional engineering advice on the feasibility of using this area as a production site for solar evaporated salt.

It was necessary to obtain meteorological data and some background history on the area to be visited while in Australia, and this paper is a report to Delhi Australian Petroleum, Ltd. and VAM, Ltd. on the findings of this assignment and recommendations.

GENERAL

Mr. A. Z. Richards, Jr., President of the consulting engineering firm of Caldwell, Richards & Sorensen, Inc., arrived in Adelaide from U.S.A. on Friday, August 8, 1969, and Mr. M. H. Montgomery, a Senior Engineer for Caldwell, Richards & Sorensen, Inc., who is engaged in work at Perth, West Australia, joined Mr. Richards in Adelaide for a conference in Mr. Charles Easley's office on this same day.

Arrangements were made with Ross Aviation for a party of five to fly from Adelaide to Port Augusta and Port Pirie the following Monday, August 11th. At 7:00 a.m. on that day assembled at the West Beach Airport were Mr. Alex Boden, Bob Adam (Engineer from the South Australia Department of Mines), Kevin J. Callow (Geologist for Delhi), Mr. Montgomery, and Mr. Richards. The weather was very favorable, and on the flight to the Port Augusta area observations were made of the 350,000 tons/year I.C.I. Solar Salt facilities at Dry Creek a few miles north of Adelaide; at the 90,000 tons/year Ocean Salt and Australia Salt partnership (Price operation) at the head of St. Vincent Gulf; at the 10,000 tons/year Bunbunga Lake project; at the abandoned salt works near Point Paterson; and also at B.H.P.'s 60,000 tons/year facilities near Whyalla on the west side of Spencer Gulf.

The view of the City of Port Augusta and of the bridge over the tide river at that location from the air was beautiful on this clear day of August 11, 1969.

See Air Photos 1, 2, 3, 4, 5, 6, 7, 8, and 9, which were taken on this flight.

Photo 1.

At Port Pirie Airport.

Photo 2.

Aerial View of Price Solar Ponds

Photo 3.

Salt Crystallizing Ponds at the Price Works

Photo 4.

Bunbunga (Salt) Lake

Photo 5.

Traveling North from St. Vincent Gulf

Photo 6.

Abandoned Salt Gardens near Point Paterson

Photo 7.

Port Augusta and the Tide River Bridge

Photo 8.

Aerial View of BHP Salt Works at Whyalla

Photo 9.

Nine (5 acre) Crystallizing Ponds at BHP Salt Works

Upon landing at Port Pirie Airport, we were met by a Department of Mines "Land Rover", which was to be our transportation for the next few days as we visited and examined the potential lands for a new Salt Project on the East side of Spencer Gulf between Port Pirie and Port Augusta. Mr. Boden returned to Adelaide with the aircraft, while the other four in the party proceeded on to the survey work with the "Land Rover".

It has been pointed out in a previous recent report by Mr. J. R. Adam (July 22, 1969) that approximately 22,076 acres of low tidal lands in the vicinity of Point Paterson, and reaching down to the area of Mt. Gullett, have been reserved from the operation of the Mining Act of South Australia for the specific purpose of making it available for one future integrated solar evaporation salt project. This reserved area is shown on the map in FIGURE 10.

Quotations from the Adam Report:

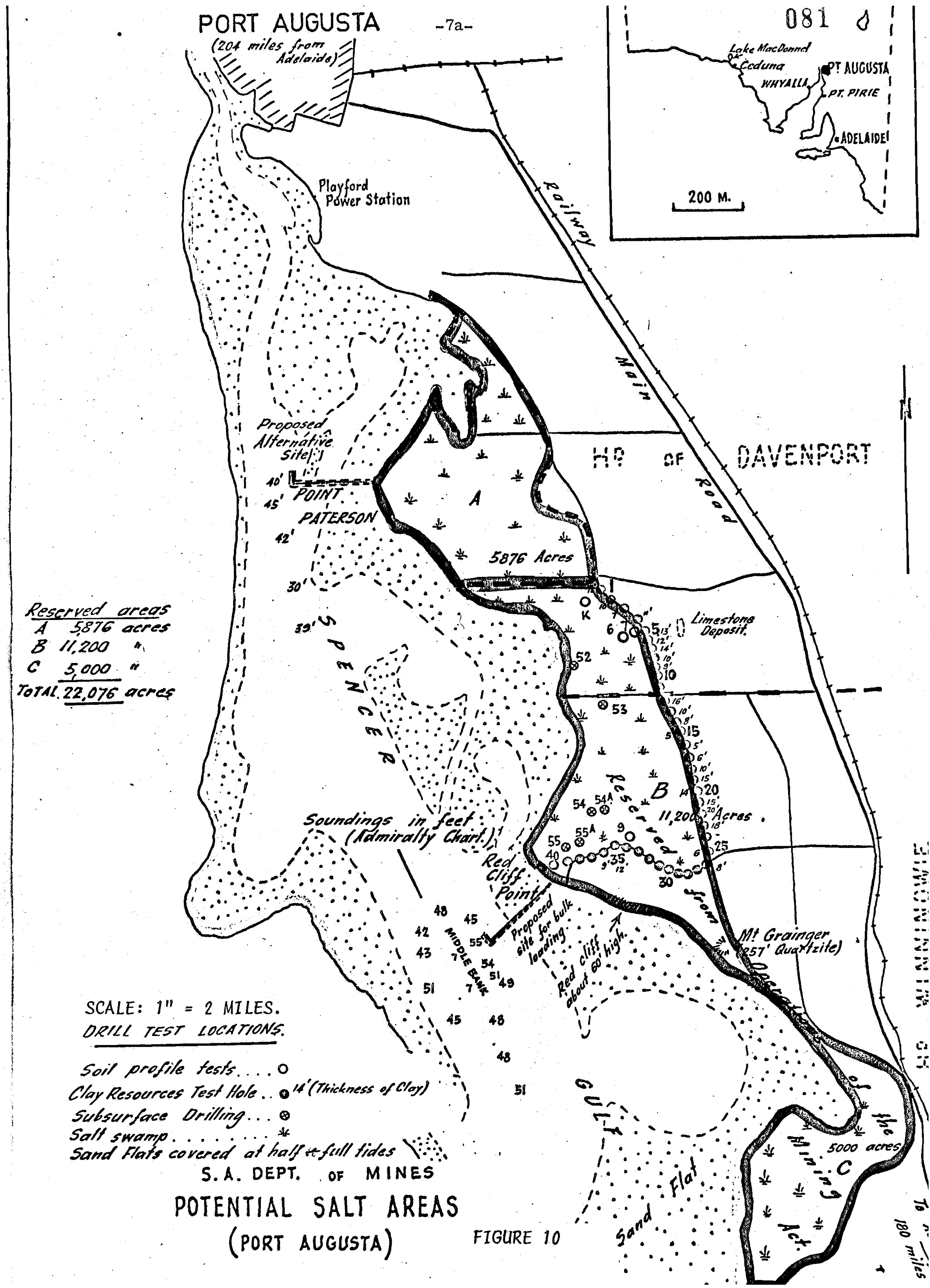
" The Point Paterson Saltfield area near Port Augusta is the most promising area available in South Australia for new large-scale solar salt development for export. These lands comprise approximately 22,000 acres.

It appears, from earlier investigations, that maximum potential of the area could be 750,000 to 1,000,000 tons of salt per annum. However, this depends very much on the effectiveness of the control of seepage, and the figures also include some 250,000 tons of possible production from an additional southern area which is separated from the main area by a 2-mile neck of unproductive land.

No bulk salt ship loading facilities are available at present, but a loading port could be constructed for 60,000 to 80,000 DWT bulk carriers. This would be in 55 feet of water about 1,000 feet off high water mark alongside the saltfield at Red Cliff Point in the sheltered waters of Spencer Gulf.

During investigations in 1961 the South Australian Government had expressed its willingness to construct suitable ship-loading facilities for the project with arrangements for the cost of construction to be paid off by an annual charge on all loadings over the first 20 years. Thus the larger the

PORT AUGUSTA



S. A. DEPT. OF MINES

POTENTIAL SALT AREAS
(PORT AUGUSTA)

FIGURE 10

annual tonnage of salt or other products, the smaller the charge would be for each ton. Such an arrangement may be possible now, but would have to be re-negotiated with the Government, as the finance may no longer be available.

Location: Near head of Spencer Gulf on east side, 190 miles by road north of Adelaide, 45 miles north of Port Pirie and 10 miles south of the town of Port Augusta, which has a population of about 10,000 from which labour could be drawn, is the location of an abandoned salt project -- known as the Point Paterson Salt Project.

High Evaporation Rate: Annual gross evaporation at Port Augusta is approximately 69 inches per annum and the average rainfall is about 9.3 inches, falling mostly in the winter months. Net evaporation is indicated at about 60 inches per annum, but some figures of 80 inches have been recorded. The area is not subject to any cyclonic storms, but is swept by winds of moderately high velocity from time to time.

High Salinity of Sea Water in Spencer Gulf: The northern waters of Spencer Gulf are about 1-1/2 times as salty as normal ocean water and they contain about 5.4% of dissolved salts compared with about 3.5% in ocean water. This high salinity is maintained throughout the year, and is caused by the Gulf being surrounded by low rainfall and high evaporation land, there being no permanent rivers or streams of fresh water entering the Gulf, and the upper reaches of the Gulf containing large areas of shallow water on sand flats, which cause high evaporation and water removal.

An analysis of sea water from the Gulf near Point Paterson shows:

Sodium	15,500	p.p.m.
Potassium	771	"
Calcium	743	"
Magnesium	2,486	"
Chlorine	29,300	"
Sulphate (SO_4)	5,100	"
Carbonate (CO_3)	100	"
Bromine	130	"
	54,130	p.p.m. = 5.41%

Area: On the eastern shore of the upper portion of Spencer Gulf a total of about 22,000 acres of coastal swamps and other land has been reserved by the South Australian Government from the operation of the Mining Act to prevent a potential large-scale salt project from being spoilt by small operators taking up portions of the area.

Potential Salt Production: Yields of over 1,000 tons of Na cl per acre of crystallizing ponds and of around 100 tons per acre for the total pond and crystallizers area is being realized at the salt fields at Whyalla which are only about 25 miles southwest of the Point Paterson area. Here 7" to 8" of salt are being harvested on the crystallizers each year.

Similar yields can be expected in the Point Paterson area provided seepage losses are well controlled and the salt production runs efficiently. Estimates of the production potential at Point Paterson have ranged from 490,000 to 750,000 tons per year from the areas A and B, with a possible 250,000 additional tons from area C. (See Map Figure 10).

At present there are about 200,000 tons of salt crystallized out in the old abandoned salt crystallizers which contain salt up to 30" thick, and additional salt has also been deposited in the old adjacent brine evaporating ponds. Some of this salt could be harvested but may need washing. But it could also be re-dissolved and deposited as a future harvest in new crystallizers.

Purity of Salt: At Whyalla, 25 miles to the southwest, the B.H.P. Company, without any washing, produce 98.4% crude salt after draining. This has been achieved by gravelling the roads and by paying attention to clean working. The analysis of salt from their stacks is:

	When stacked	After draining
Common salt	91.83%	98.4%
Magnesium chloride	6.11%	0.26%
Calcium sulphate	1.36%	0.68%
Sodium sulphate	0.6%	--
Magnesium sulphate		0.20%
Insolubles	0.1%	0.1%
Iron oxide		0.01%

Some idea of the purity of salt to be expected from Point Paterson can be gained from the following table of the assays of samples taken from the salt at present in the crystallizers. (Note: Many of the samples were taken from below water level, so some washing may have taken place during sampling).

AUGUSTA SALT SAMPLES

Samples taken from holes cut in the Crystallizers - October, 1967

Note: - Assays are on Water Free Basis.

Analysis
%

Augusta Salt	Sodium Chloride NaCl	Calcium Sulphate $CaSO_4$	Magnesium Sulphate $MgSO_4$	Magnesium Chloride $MgCl_2$	Potassium Chloride KCl	Water Insoluble Matter
1	99.0	0.34	0.13	0.39	0.07	0.02
3	99.4	0.14	0.14	0.24	0.06	0.01
4	99.0	0.27	0.22	0.35	0.10	0.06
5	99.4	0.20	0.13	0.20	0.06	0.05

Analysis % - Continued

Augusta Salt	Sodium Chloride NaCl	Calcium Sulphate $CaSO_4$	Magnesium Sulphate $MgSO_4$	Magnesium Chloride $MgCl_2$	Potassium Chloride KCl	Water Insoluble Matter
6	96.9	0.54	0.79	1.41	0.20	0.12
7	98.4	0.27	0.44	0.75	0.15	0.04
8	98.0	0.31	0.66	0.75	0.25	0.02
9	99.0	0.20	0.19	0.51	0.08	0.06
10	99.1	0.44	0.15	0.23	0.06	0.03
11	99.0	0.34	0.16	0.40	0.08	0.03
12	98.2	0.54	0.28	0.67	0.12	0.20
13	98.9	0.58	0.18	0.24	0.08	0.06
14	98.8	0.20	0.38	0.51	0.09	0.04

Note: The above analyses are calculated to a water free basis. The water was determined by drying at 250°C, at which temperature both hydroscopic and combined water would be driven off.

Ground Condition: The ground consists mainly of open samphire or bare flats, with little mangrove cover except along the shore itself. The surface soil is principally yellow-coloured silt, cohesionless when wet and liable to wind erosion when dry. A better, red-coloured loam outcrops in places along the landward side and now appears to underlie some of the area. Sand is found in places, and areas of gravel and travertine limestone occur on the landward side. The general level is above that of all but exceptionally high tides. A natural levee exists along the seaward side in places, and this has been utilized as a sea wall. It may be (and has been) breached during high tides.

Subsurface: Some subsurface drilling results are available. Where these are available they show that the bed is made up of different grades of silt, the upper layers of which are permeable, but impermeable beds were reached at depths varying from 5 ft. to 24 ft. below surface. The log of bore No. 53 is given as fairly typical of these sections.

Bore No. 53

Depth	Description	Permeability	Tube Recovery
0" - 10'0"	No sample		
10'0" - 13'0"	Grey very shelly calc. silt with abundant fibrous roots - very soft.	P.	
13'0" - 16'0"	do.		
16'0" - 19'0"	L. grey very calc. silt - soft	M.L.P.	
19'0" - 20'6"	do.	"	+
20'6" - 22'0"	Green-grey mottling very calc. silt - firm.	Imp.	+
22'0" - 24'0"	Green-grey mottling very calc. silt - shelly.	"	
24'0" - 25'6"	Brown-grey mottled silt - very firm.	"	+

Clay Resources: Shallow pits and auger drilling has shown that plenty of clay is available round the edges of the flats.

Quartzite Deposit: Mount Grainger, an isolated hill rising to 257' about three miles from the proposed Red Cliff Point loading site, contains ample stone for wave breaks, causeways, etc. (M.R. 116).

Limestone Resources: A deposit of limestone of recent origin which may be suitable for bank and road construction, is available 1 mile east of the salt leases and 10 miles southeast of Port Augusta. The deposit consists of fairly hard limestone, about 30' thick, proved by diamond drilling to be about 30' thick under 10' - 20' of overburden, and extends almost half a mile under a cover of kunkar and clays. Reserves are probably about 3-1/2 million cubic yards under about 1-1/2 million cubic yards of softer material. Further tests would be necessary if this material was required for causeways or bank protection. (M.R. 117 and 120).

Tides: A maximum high tide of 15 ft. was recorded in 1952, the predicted tide was 12 ft. 4 ins., but wind and the barometer increased this to 15 ft. The average of all spring tides is 10 ft. and of neap tides is 6 ft.

Weather: The Gulf is very sheltered so there is little likelihood of shipping delays, probably only a day or so a year.

General Facilities: A main bitumen road runs parallel to the field and only three miles off. The main east-west railway is alongside the road. E.T.S.A. Power supply is within four miles parallel to the lease, and the Morgan-Whyalla freshwater main is beside the road. The Port Augusta aerodrome is about 20 miles from the field.

Possibility of Bulk Loading Facilities being provided by the Government: Arrangements had been completed with L.J. Hooker Investments Co. Ltd. for the South Australian Government to provide bulk loading facilities at Point Paterson for 15,000 DWT ships at an estimated cost of $A2,400,000 in 1962. Now it is thought that a better location would be off Red Cliff Point where up to 70,000 DWT ships could be handled.

The Point Paterson Scheme was to provide a 7,000 ft. causeway for motor trucks on to a 3,000 ft. square island storage off Point Paterson. This was designed initially for 15,000 DWT bulk carriers to be warped (in 40 ft. of water at low tide) past a conveyor from a loading tower, and loaded at 600 tons per hour average. Provision was made for expansion to take up to 40 - 45,000 DWT vessels at peak loading rate of 1,500 tons per hour. A rock bar (30' at low water) might have to be deepened. The stockpile "island" would hold two 20,000 ton heaps of salt, piled by a fixed inclined belt and dozed out, and reclaimed by tunnel and conveyor to a 750' conveyor to the ship loading point. This arrangement should be suitable for up to 4 - 500,000 long tons per annum in up to 30,000 DWT ships. Operating costs were estimated at $A250,000, including labour on salt haulage trucks for 200,000 tons per annum, i.e. $1.25 per long ton. This would reduce to about 60 cents per ton for 500,000 tons per annum. The capital cost would rise to about $2,800,000 if built for 45,000 DWT ships.

The Red Cliff Point Scheme was to use conveyor belts all the way, from a land based stockpile to a loading point 10,000 ft. away. Maximum loading rate was to be 1,000 tons per hour and ships of 60,000 to 80,000 DWT could be loaded. Ships would turn round the "Middle Bank" off Red Cliff Point and have a minimum low water depth of 48' on way out to sea. Scheme was estimated to cost $A3 million in 1962. Operating costs were expected to be about $3 per long ton for 100,000 tons per year, reducing to about $1 per ton for 300,000 tons per year and lower for larger tonnages.

For either scheme - Tugs would not be required. Pilotage would be about $200 per vessel visit. No ships bunkerage has been allowed for, but water for ships purposes has been included. If any grain, barytes, or other cargo is handled, this would reduce the operating charges on the salt. (End of J. R. Adam's report).

DISCUSSION OF THE ADAM REPORT

Mr. Adam has very ably described the Point Paterson area and has given us some good information with regards to the salinity of the sea water in Spencer Gulf and the purity of the salt which was harvested from existing salt floors in the old Hooker Salt Project at this location. He has also reviewed the Red Cliff Point Scheme which is proposed for loading ships near Middle Bank in the Spencer Gulf. We will supplement this very good information with our additional findings in connection with the meteorological conditions and the soil conditions in the Point Paterson area later in this report. We compliment Mr. Adam in his documenting of this pertinent information regarding solar evaporated salt production.

DESCRIPTION OF THE POINT PATERSON AREA

On the accompanying map (Figure 11) we have indicated two areas which, in our opinion, can be used for solar salt production. This opinion is based only on a reconnaissance visit to the area by airplane observation and on the ground by Land Rover. It appears to us that about 10,000 acres are available for solar evaporating ponds in the Point Paterson area, and about 2600 acres are available in the secondary area near Mount Gullett. In making our estimate of the available areas for solar evaporation, we have skirted or eliminated the mangrove covered areas because of the difficulty in clearing these areas of vegetation. Dikes will not be required along the eastern edges of both of these areas which are skirting high ground. Accurate topographic information and contours along this eastern edge of the available area will be required before the exact extent of usable land can be determined.

The description of this area can best be given by photographic illustration and, therefore, throughout this report we have used a number of photographs which were taken at the time of our reconnaissance survey. Photos 10, 11, and 12 are aerial views of the main dike separating Spencer Gulf from the Hooker Salt Project. This dike was constructed a few years ago and is deteriorating rapidly, as shown in Photo 13. As indicated by Mr. Adam, the average spring tides are about 10 feet high, and photograph 13 was taken at a time of low tide, the boats being at Spencer Gulf level and the lake behind the dike being somewhat higher in elevation.

We would recommend rebuilding, reinforcing and improving this existing dike as the initial step in any new salt project. This would be a major item of expense, but provides an excellent means of easy access to the Spencer Gulf sea water brine. The pumping plant would be rebuilt, and heavy rock facing would be placed on both sides of the dike to withstand the tides and wave action. Photograph 14 shows a view of Pond No. 1 looking easterly from the pump house location. A hydrometer check at the time of our visit showed this brine west of the main dike to have a density of approximately 12 Baume', which was a little less than three times the density of the brine in Spencer Gulf. We did not have the proper hydrometer to determine the Spencer Gulf water density, but have used the figure 5.4% dissolved salt, as reported by Mr. Adam on page 8 of this report.

Photo 10

Aerial View Looking East. Main Dike of Abandoned Hooker Project.

Photo 11

Aerial View Looking Southerly

Photo 12

Aerial View Looking West. Spencer Gulf in Background.

Photo 13

Main Dike Tidewater Side Showing Deterioriation of Red Fill Material.

Photo 14

Brine Pond Behind Main Dike Looking East.

Photo 15

Aerial View Looking North. Hooker Crystallizing Ponds in Foreground.

Photo 16

Aerial View Looking Northwesterly. Spencer Gulf in Background.

Photo 17

Aerial View Looking Easterly. Hooker Abandoned Crystallizer Pond.

Photo 18

Typical Hand Made Dike Looking Northerly.

Photographs 18, 19 and 20 were taken on existing dikes of the Hooker Project, which is now inoperative and has been abandoned.

In Photograph 19 we are shown making a hydrometer reading in some of the existing brine at this project. We determined the density of the brine to be between 25° and 26° Baume' during this month of August, and inasmuch as salt crystals were forming at the time measurements were taken, it indicates that this is a very high quality brine. Lower quality brines do not commence making crystals until they are over 26° Baume'. As seen in Photo 20, the main central dike for the crystallizer is about 16 feet wide and appears to be in excellent condition. The only improvement that we would recommend for dikes in this location would be some rock or granular materials on the slope faces of the dike to eliminate erosion which is apparent at the toes of the slope in this picture.

Photo 19

Checking Temperature and Density of Existing Brine with Thermometer and Hydrometer.

Photo 20

Typical Center Dike in Hooker Project.

Two other views of the land in the vicinity of the Hooker Project are shown in Photographs 21 and 22.

Photo 21

Future Evaporating Pond Area. Looking Westerly from Existing Crystallizer Area - Spencer Gulf in Background.

Photo 22

Saline and Bittern Covered Bottoms of Old Evaporating Ponds in Hooker Project.

Photo 23

Typical View of Mud Glats Between Point Paterson and Chinaman Creek.

A typical condition of the land between Point Paterson and Red Cliff Point is illustrated in Photograph 23. Photo 24 is an aerial view looking north-westerly from a point almost directly above Mt. Grainger. This shows a prime area available for crystallizing ponds in the vicinity easterly of Chinaman Creek.

Photo 24

Aerial View Looking Northwest from a Point Over Mt. Grainger.

Photo 25

Shell Covered Beach Land Not Usable for Evaporating Ponds.

Photograph 25 shows a typical beach area covered with shells. This land is not usable for evaporating ponds because it is not sufficiently impervious to hold the water.

All along the beach from Red Cliff Point to Point Paterson are small tide-river channels. A typical one is shown in Photograph 26. This is Chinaman Creek looking east from a point over the Spencer Gulf Beach and toward the future proposed evaporating pond area.

On the ground these small tide-river inlets appear as small standing water creek channels. A typical one is shown in Photograph 27. Or they may appear as shallow, dry channels, as shown in Photograph 28. During future construction of this proposed project, many of these little tidewater river channels will be cut off by the major coastline dike, and some land leveling will have to take place to fill up and obliterate these natural depressions in order to make relatively level floors for the ponds.

Photo 26

Aerial View Looking East from a Position Over Red Cliff Point.
Chinaman Creek in Foreground.

Photo 27

A Typical Small Tide River Inlet.

Photo 28

Shallow Dry Channel Mde by Tide Water Inlet.

Photo 29

Making Borings to Determine Soil Conditions.

In order to determine the general nature of the soil on these natural mud flats, we made borings down to a depth of approximately 3 feet, as shown in Photograph 29. The results of these tests are given later in this report.

Photo 30

Looking Southeasterly from Airplane with Mount Grainger in Foreground. Area "C" in Background.

DESCRIPTION OF AREA "C" NEAR MT. GULLETT.

As shown on the drawing (Figure 11), we have outlined a 2600 acre area separated about 2-1/2 miles from the southern end of the Point Paterson Project by the high lands surrounding Mt. Grainger. Our reconnaissance examination of this tract indicates it to be very good land for solar evaporation pond. Photographs 30 and 31 show this land in the background. In the foreground is seen a tide river running southeasterly from Yatala Harbor. In the foreground also is shown the mangrove swamp area that is covered with thick vegetation.

On the map (Figure 11) you will note that we have avoided the mangrove areas in outlining the land recommended for solar evaporation ponds. We have done this for two reasons. These areas generally are lower and nearer the ocean beach. Secondly, it would be rather expensive to defoliate this heavy vegetation, except that the salt brine would eventually kill the vegetation and defoliate it. Unless the brush is burned, it will remain as an obstruction in the pond, as shown in a previous photograph, No. 14. Also, the largest of the tide rivers occur in these mangrove swamps, and heavier dikes than normal will have to be maintained to cut them off from the ocean water. With some expense, however, these areas can be utilized in the future, although we are not including them in our present recommendations. Possibly another 2,000 acres could come under use for expansion of the project in future years, if needed.

A discussion of the use of this particular property known as Area "C" near Mt. Gullett, appears later in this report under the heading "Suggested Preliminary Layout".

FINDINGS ON PRESENT SALT PRODUCERS.

The principle present producer of salt in South Australia is I.C.I. Alkali Pty. Ltd. located at Dry Creek. In 1962, total production for all of

Photo 31

Aerial View Looking Southeasterly from Yatala Harbour. Mangrove Swamps in Foreground.

Photo 32

Tide River Running Southeasterly from Yatala Harbour. Mangrove Swamps in Foreground.

Photo 33

Typical Mangrove Area in the Vicinity of the Main Dike - Point Paterson Area.

Photo 34

In Mangrove Swamp Showing Typical Size of Vegetation.

South Australia was only 389,600 tons and only a little expansion appears to have taken place since that time.

B.H.P. Co. Ltd. is now harvesting around 60,000 tons annually at Whyalla but is presently considering expanding it's solar salt production facilities to possibly 500,000 tons annually. The other principle producer is Ocean Salt Pty. Ltd. with operations at Price, Lake Bunbunga, and on the Yorke Peninsula.

It has been demonstrated for many years that salt can be produced econmically from sea water in this area, and in view of Japan's unsatisfied need for several million tons annually an important justification is provided for investigating additional production sites in South Australia.

FINDINGS ON METEORLOGICAL CONDITIONS.

Cyclones. Although rates of evaporation normal to the climate of South Australia are less than that found in the more norther parts of Western Australia and the anticipated production of salt will therefore be less per acre, cyclonic and thunderstorm activity is nearly the minimum for all of Australia here in the Spencer Gulf area.

Fig. 12 shows (quoting from the Bureau of Meterology's Bulletin No. 1) "the number of days annually on which thunder is heard, which is a better observational criterion than lightning observed. The region of maximum thunderstorm activity is the extreme northwest part of the continent and the region southeast of the Gulf of Carpentaria. The minimum number of storms occur over South Australia, western New South Wales and eastern Tasmania."

Unusual storms still do arise in South Australia, as you know, and tides at 15 feet have been know to occur in Spencer Gulf, (See photo 35) but relative security does exist here against the devastation of cyclones and semi-tropical monsoons that are prevalent in other areas of Australia where major salt projects are now being built. This factor can be counted

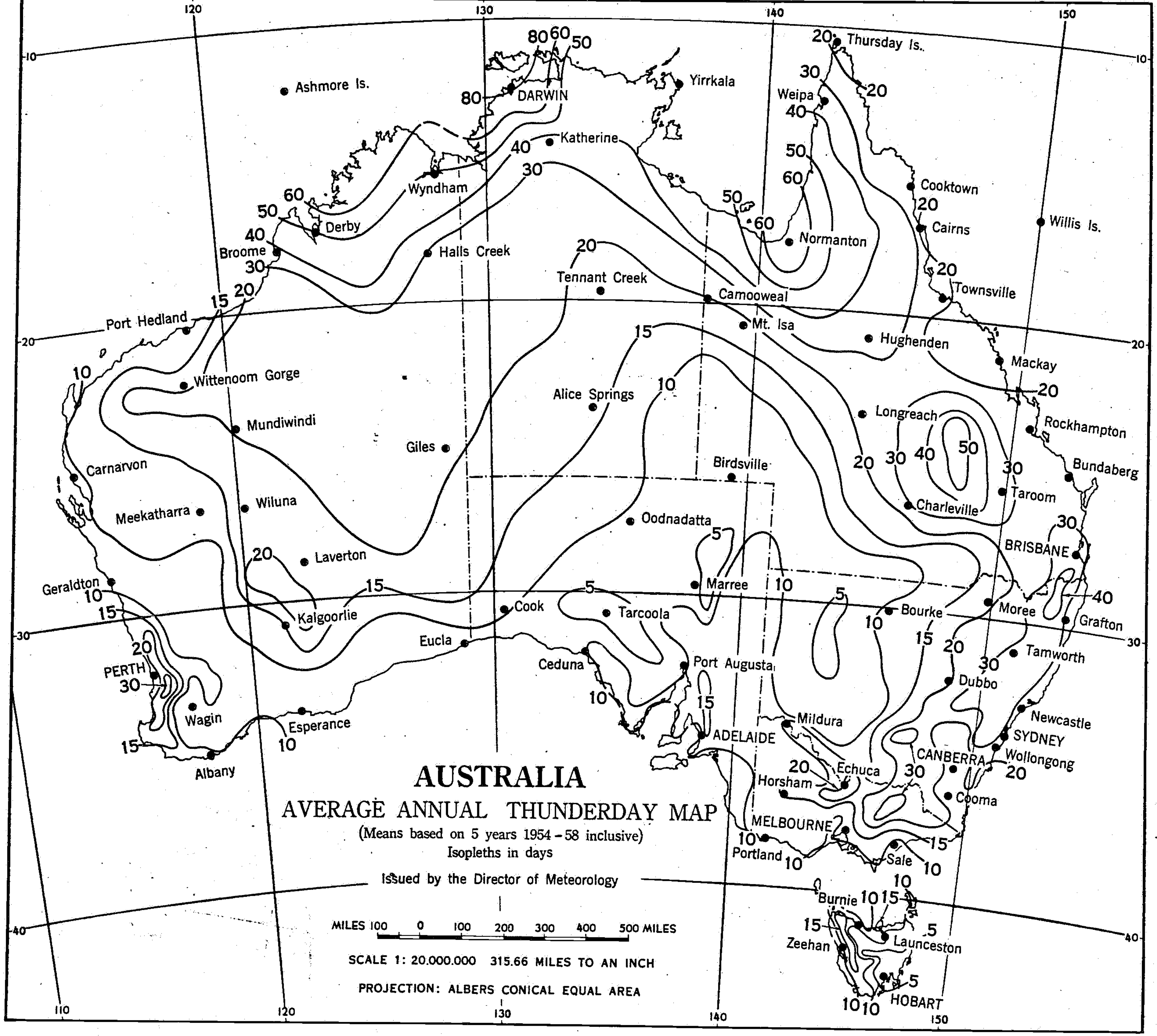

AUSTRALIA
AVERAGE ANNUAL THUNDERDAY MAP
(Means based on 5 years 1954 - 58 inclusive)
Isopleths in days
Issued by the Director of Meteorology
MILES 100 0 100 200 300 400 500 MILES
SCALE 1: 20.000.000 315.66 MILES TO AN INCH
PROJECTION: ALBERS CONICAL EQUAL AREA
Ashmore Is.
DARWIN
Katherine
Yirrkala
Thursday Is.
Weipa
Cooktown
Cairns
Willis Is.
Townsville
Normanton
Wyndham
Derby
Broome
Halls Creek
Tennant Creek
Camooweal
Mt. Isa
Hughenden
Mackay
Port Hedland
Wittenoom Gorge
Mundiwindi
Alice Springs
Longreach
Rockhampton
Bundaberg
Giles
Carnarvon
Birdsville
Taroom
Charleville
Meekatharra
Wiluna
Oodnadatta
BRISBANE
Laverton
Marree
Geraldton
Kalgoorlie
Cook
Tarcoola
Bourke
Moree
Grafton
Eucla
Tamworth
Ceduna
Port Augusta
Dubbo
PERTH
Wagin
Esperance
Mildura
Newcastle
ADELAIDE
SYDNEY
Albany
CANBERRA
Wollongong
Echuca
Horsham
Cooma
MELBOURNE
Portland
Sale
Burnie
Zeehan
Launceston
HOBART

FIGURE 12.

upon to offset, in some degree, the higher evaporation and production rates of the competitive areas of Western Australia.

Photo 35

Driftwood was observed possibly 15 feet above low tide on far-inland upper lands. This is a serious condition which must be dealt with in design of new evaporating ponds.

Rainfall and Net Evaporation. We visited the Bureau of Meteorology office, South Terrace, at Adelaide and found that complete data on rainfall and evaporation were available for Adelaide (See Chart Fig. 13). We copied rainfall information from the Bureau's record for Port Agusta (See Chart Fig. 14), and found the 30 year mean rainfall and evaporation to be as follows:

Location	Annual Rainfall	Net Annual Evaporation
At Adelaide	21.09"	57.68"
At Port Agusta	9.87"	(no info)
At Whyalla*	10.22"	66.61"

*10 year private record from B.H.P. Salt Plant at Whyalla. (See Chart Figure 15.)

(continued on page 33)

CLIMATOLOGICAL DATA: ADELAIDE, SOUTH AUSTRALIA

(Lat. 34° 56′ S., Long. 138° 35′ E. Height above M.S.L. 140 ft.)

BAROMETER, WIND, EVAPORATION, LIGHTNING, CLOUDS AND CLEAR DAYS

Month	Bar. corrected to 32° F. mn. sea level and standard gravity from 9 a.m. and 3 p.m. readings	Wind (Height of anemometer 75 feet) Average miles per hour	Highest mean speed in one day (miles per hour)	Highest gust speed (miles per hour)	Prevailing direction 9 a.m.	Prevailing direction 3 p.m.	Mean amount of evaporation (inches)	No. of days of lightning	Mean amount of clouds, 9 a.m., 3 p.m. 9 p.m.(a)	No. of clear days
No. of years of observations.	30(b)	13(c)	13(c)	48	30(b)	30(b)	30(b)	30(b)	30(b)	30(b)
January	29.917	7.8	18.2 3/55	72	SW	SW	9.27	2.3	3.6	12.9
February	29.953	7.5	17.7 1/64	66	NE	SW	7.56	2.0	3.7	11.2
March	30.037	6.9	19.1 24/64	78	S	SW	6.39	1.8	4.0	10.6
April	30.119	6.9	23.2 10/56	81	NE	SW	3.78	1.5	5.2	7.2
May	30.131	7.0	23.5 19/53	70	NE	NW	2.27	1.3	5.8	4.9
June	30.119	7.4	18.4 12/53	67	NE	N	1.37	1.3	6.1	4.1
July	30.111	7.3	20.4 13/64	60	NE	NW	1.34	1.5	6.0	4.3
August	30.084	7.9	23.7 8/55	75	NE	SW	1.99	2.0	5.5	5.6
September	30.050	8.0	21.0 25/60	69	NNE	SW	3.05	2.0	5.3	5.8
October	30.007	8.4	21.9 6/62	75	NNE	SW	5.03	2.8	5.3	5.7
November	29.990	8.4	20.6 8/52	81	SW	SW	6.89	3.3	4.9	7.2
December	29.922	8.2	17.9 6/52	75	SW	SW	8.74	2.2	4.2	9.5
Year Totals	..	..	..	..	..	..	57.68	24.0	..	89.0
Year Averages	30.037	7.7	..	..	NE	SW	..	..	5.0	..
Year Extremes	..	..	23.7 8/1955	81	..	..	..	..	..	..

(a) Scale 0–10. (b) Standard thirty years' normal (1911–1940). (c) Records taken from a Munro Anemometer, 1952–1964.

TEMPERATURE AND SUNSHINE

Month	Mean temperature (°Fahr.) Mean max.	Mean min.	Mean	Extreme shade temperature (°Fahr.) Highest	Lowest	Extreme range	Extreme temperature (°Fahr.) Highest in sun	Lowest on grass	Mean daily hours of sunshine
No. of years over which observation extends.	30(a)	30(a)	30(a)	108	108	108	54(b)	104	30(a)
January	84.8	61.0	72.9	117.7 12/39	45.1 *21/84*	72.6	180.0 *18/82*	36.5 *14/79*	10.0
February	85.7	61.8	73.7	113.6 *12/99*	45.5 23/18	68.1	170.5 10/00	35.8 23/26	9.3
March	81.3	59.1	70.2	110.5 9/34	43.9 21/33	66.6	174.0 *17/83*	32.1 21/33	7.9
April	73.0	54.4	63.7	98.6 5/38	39.6 *15/59*	59.0	155.0 *1/83*	28.0 14/63	6.0
May	66.8	50.8	58.8	89.5 4/21	36.9 (c)	52.6	148.2 *12/79*	25.6 19/28	4.8
June	61.0	46.6	53.8	78.1 4/57	32.5 (d)	45.6	138.8 *18/79*	21.0 24/44	4.2
July	59.9	45.4	52.7	74.0 11/06	32.0 24/08	42.0	134.5 *26/90*	22.1 30/29	4.3
August	62.3	46.2	54.3	85.0 31/11	32.3 *17/59*	52.7	140.0 *31/92*	22.8 11/29	5.4
September	66.8	48.3	57.5	95.1 30/61	32.7 *4/58*	62.4	160.5 *23/82*	25.0 25/27	6.3
October	72.5	51.7	62.1	102.9 21/22	36.1 *20/58*	66.8	162.0 30/21	27.8 (e)	7.3
November	78.1	55.4	66.7	113.5 *21/65*	40.8 2/09	72.7	166.9 *20/78*	31.5 2/09	8.6
December	82.6	58.9	70.7	114.6 29/31	43.0 (f)	71.6	175.7 *7/99*	32.5 *4/84*	9.5
Year Averages	72.9	53.3	63.1	..	..	..	..	..	7.0
Year Extremes	..	..	..	117.7 12/1/39	32.0 24/7/08	85.7	180.0 18/1/1882	21.0 24/6/44	..

(a) Standard thirty years' normal (1911–1940). (b) Records incomplete, 1931–1934. Discontinued, 1934. (c) 26/1895 and 24/1904. (d) 27/1876 and 24/1944. (e) 4/1931 and 2/1918. (f) 4/1906 and 16/1861.

HUMIDITY, RAINFALL AND FOG

Month	Vapour pressure (inches) Mean 9 a.m.	Rel. hum. (%) at 9 a.m. Mean	Highest mean	Lowest mean	Rainfall (inches) Mean monthly	Mean No. of days of rain	Greatest monthly	Least monthly	Greatest in one day	Fog Mean No. of days of fog
No. of years over which observation extends.	30(a)	30(a)	97	97	30(a)	30(a)	126	126	126	30(a)
January	0.327	39	59	29	0.76	5	3.31 1941	Nil (b)	2.30 *2/89*	0.0
February	0.352	41	57	30	1.10	5	6.09 1925	Nil (b)	5.57 7/25	0.0
March	0.332	44	58	29	0.87	5	4.59 1878	Nil (b)	3.50 *5/78*	0.0
April	0.329	55	72	37	1.45	10	5.81 1938	Nil 1945	3.15 *5/60*	0.0
May	0.313	64	76	49	2.49	13	7.75 1875	0.10 1934	2.75 *1/53*	0.6
June	0.294	75	84	63	2.93	15	8.58 1916	0.23 1958	2.11 1/20	1.1
July	0.282	75	87	66	2.49	16	5.44 1890	0.39 1899	1.75 *10/65*	1.4
August	0.282	68	78	54	2.58	16	6.20 1852	0.33 1944	2.23 *19/51*	0.4
September	0.289	59	72	44	2.39	13	5.83 1923	0.27 1951	1.59 20/23	0.2
October	0.287	48	67	29	1.54	10	5.24 1949	0.17 1914	2.24 16/08	0.0
November	0.292	41	58	31	1.22	8	4.45 1839	0.08 1922	2.96 12/60	0.0
December	0.322	40	56	31	1.27	6	3.98 1861	Nil 1904	2.42 23/13	0.0
Year Totals	..	..	..	..	21.09	122	..	..	..	3.7
Year Averages	0.308	54	..	..	..	..	..	..	..	..
Year Extremes	..	..	87	29	..	..	8.58 6/1916	Nil(c)	5.57 7/2/25	..

(a) Standard thirty years' normal (1911–1940). (b) Various years. (c) December to April, various years.
Dates in italics relate to nineteenth century.

FIGURE 13.

MONTHLY MEAN RAINFALL AT PORT AGUSTA, SOUTH AUSTRALIA

(From Bureau of Meteorology Bulletin - Rainfall Statistics of South Australia, Nov. 1968)

MONTH	(30 year Record 1931 to 1960) RAIN DAYS	INCHES RAINFALL	(102 year Record 1860 to 1962) INCHES RAINFALL
January	3	.73"	.59"
February	3	.109"	.66"
March	3	.55"	.66"
April	5	.73"	.75"
May	7	.83"	1.02"
June	7	.93"	1.07"
July	10	.89"	.77"
August	9	.94"	.88"
September	6	.73"	.88"
October	6	1.08"	.91"
November	6	.74"	.71"
December	4	.63"	.63"
	30 YEAR AVERAGE →	9.87"	9.53" ← 102 YEAR AVERAGE

FIGURE 14.

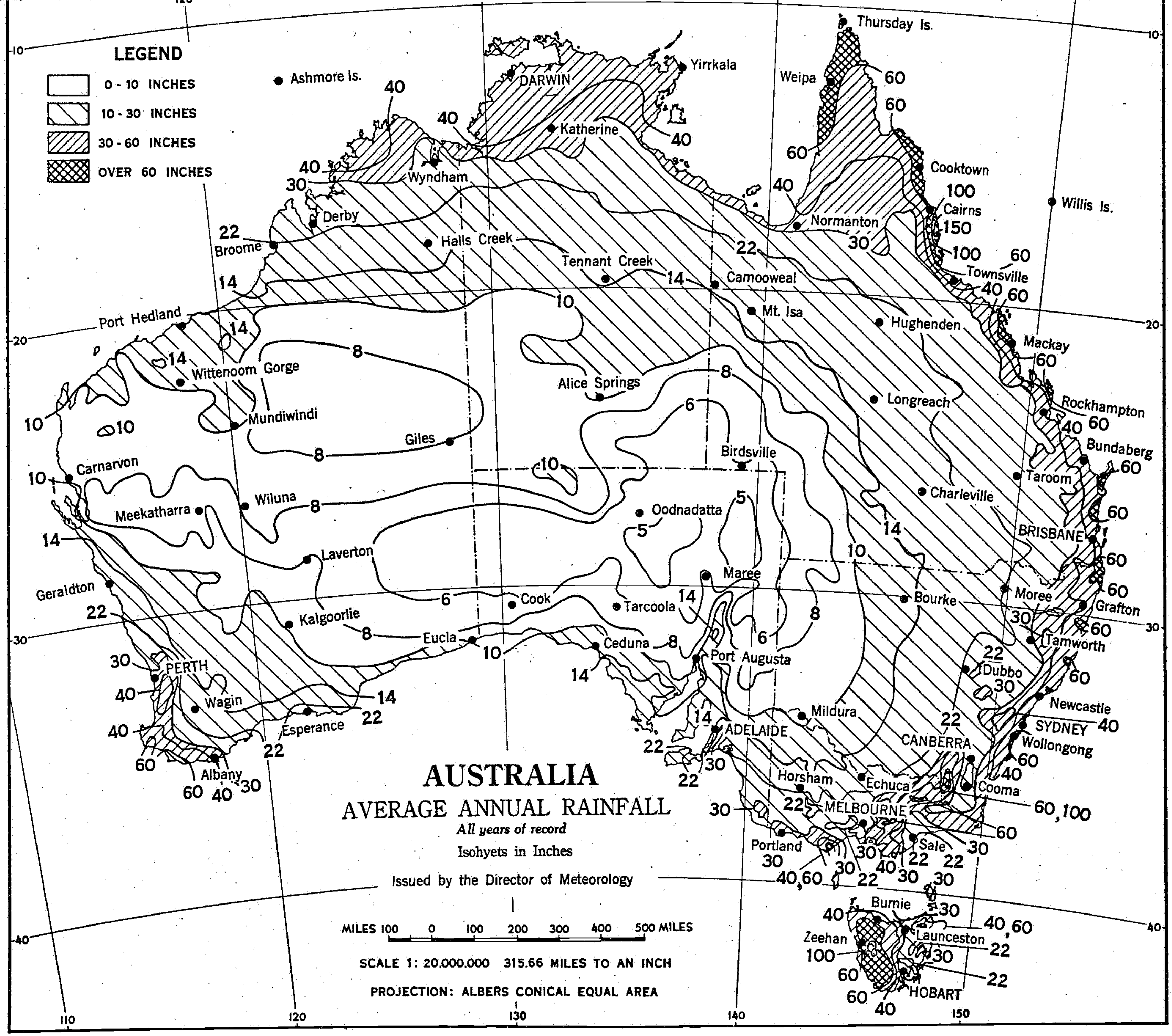

LEGEND
0 - 10 INCHES
10 - 30 INCHES
30 - 60 INCHES
OVER 60 INCHES
AUSTRALIA
AVERAGE ANNUAL RAINFALL
All years of record
Isohyets in Inches
Issued by the Director of Meteorology
MILES 100 0 100 200 300 400 500 MILES
SCALE 1: 20,000,000 315.66 MILES TO AN INCH
PROJECTION: ALBERS CONICAL EQUAL AREA
DARWIN
Katherine
Wyndham
Derby
Broome
Halls Creek
Tennant Creek
Camooweal
Mt. Isa
Port Hedland
Wittenoom Gorge
Mundiwindi
Giles
Alice Springs
Carnarvon
Meekatharra
Wiluna
Laverton
Geraldton
Kalgoorlie
Eucla
Cook
Tarcoola
Ceduna
Port Augusta
PERTH
Wagin
Esperance
Albany
Oodnadatta
Birdsville
Maree
ADELAIDE
Mildura
Horsham
Echuca
MELBOURNE
Portland
Sale
Burnie
Zeehan
Launceston
HOBART
CANBERRA
Cooma
SYDNEY
Wollongong
Newcastle
Dubbo
Tamworth
Grafton
Moree
Bourke
BRISBANE
Charleville
Taroom
Bundaberg
Rockhampton
Longreach
Hughenden
Mackay
Townsville
Cairns
Cooktown
Normanton
Weipa
Thursday Is.
Yirrkala
Ashmore Is.
Willis Is.

FIGURE 16.

-30-

RAINFALL DATA

Averages from Several Years Records

MONTH	AT WHYALLA, S.A.(*)	AT PORT AGUSTA, S.A.(**)	RAIN DAYS
January	0.60 Inches	0.73 Inches	3
February	0.75	1.09	3
March	0.63	0.55	3
April	1.22	0.73	5
May	0.80	0.83	7
June	0.79	0.93	7
July	1.00	0.89	10
August	0.71	0.94	9
September	1.16	0.73	6
October	0.86	1.08	6
November	1.00	0.74	6
December	0.70	0.63	4
Totals	10.22 Inches	9.87 Inches	69 Days

(*) Ten year record 1952 to 1961 from Mr. W. Havelberg, Supt., B.H.P. Salt Plant, Whyalla.

(**) 30 year record (1931 to 1960) from So. Australia Rainfall Statistics 9/66.

FIGURE 15

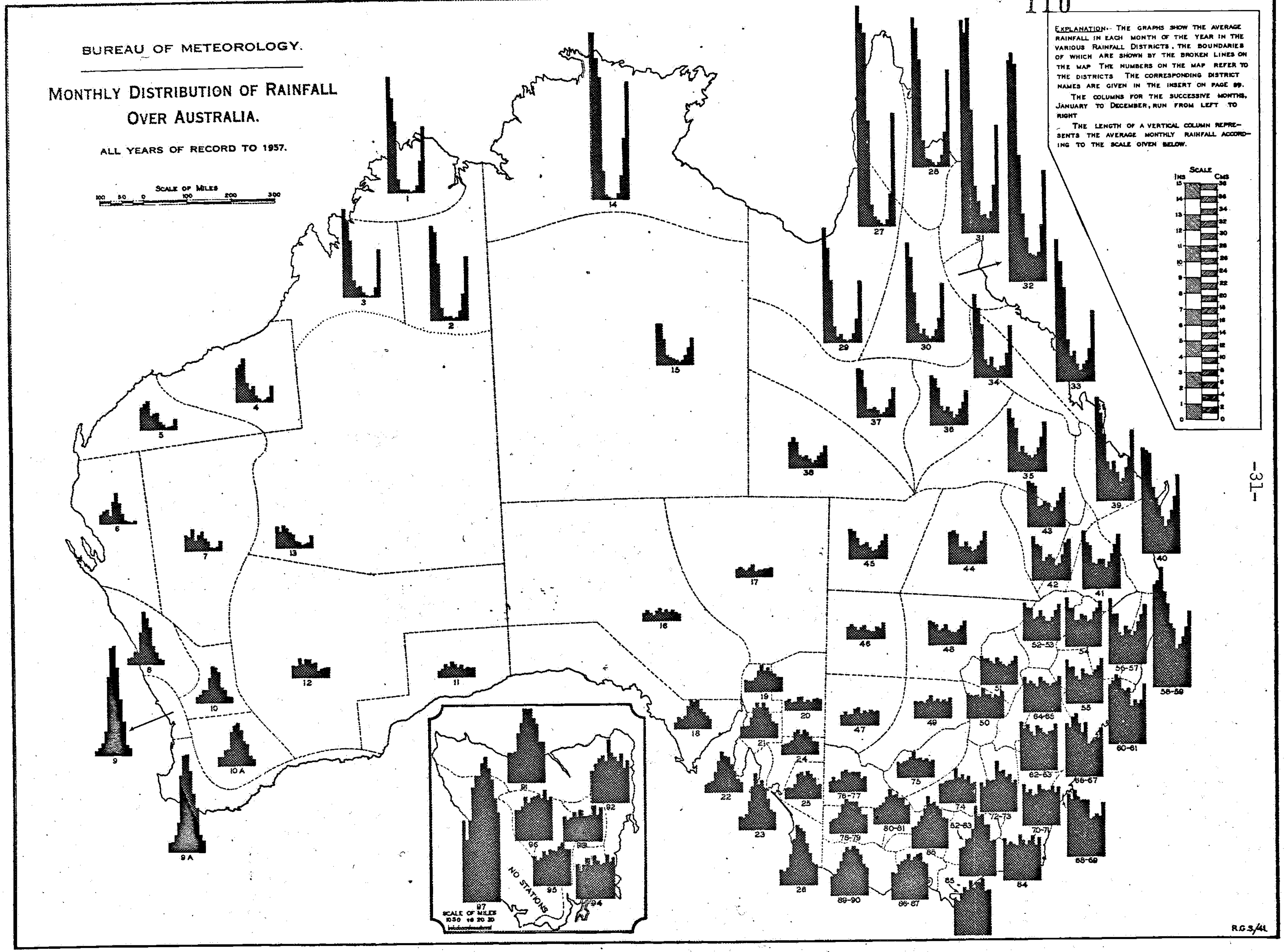

BUREAU OF METEOROLOGY.
MONTHLY DISTRIBUTION OF RAINFALL OVER AUSTRALIA.
ALL YEARS OF RECORD TO 1957.
SCALE OF MILES
100 50 0 100 200 300
EXPLANATION.- THE GRAPHS SHOW THE AVERAGE RAINFALL IN EACH MONTH OF THE YEAR IN THE VARIOUS RAINFALL DISTRICTS, THE BOUNDARIES OF WHICH ARE SHOWN BY THE BROKEN LINES ON THE MAP THE NUMBERS ON THE MAP REFER TO THE DISTRICTS THE CORRESPONDING DISTRICT NAMES ARE GIVEN IN THE INSERT ON PAGE 89.
THE COLUMNS FOR THE SUCCESSIVE MONTHS, JANUARY TO DECEMBER, RUN FROM LEFT TO RIGHT
THE LENGTH OF A VERTICAL COLUMN REPRESENTS THE AVERAGE MONTHLY RAINFALL ACCORDING TO THE SCALE GIVEN BELOW.
SCALE
INS
CMS
NO STATIONS
SCALE OF MILES
R.G.S./41.

FIGURE 17

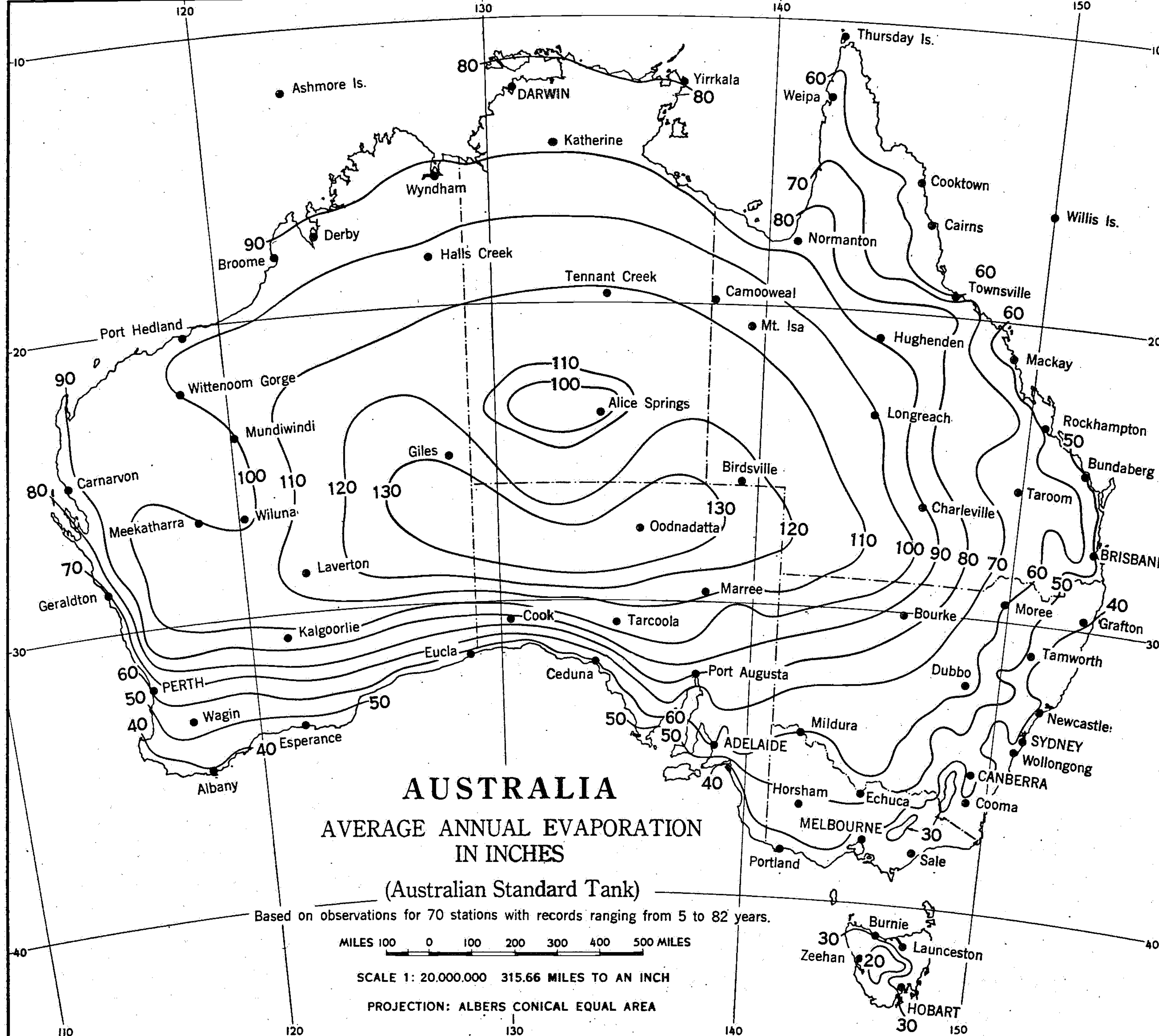

AUSTRALIA
AVERAGE ANNUAL EVAPORATION IN INCHES
(Australian Standard Tank)
Based on observations for 70 stations with records ranging from 5 to 82 years.
MILES 100 0 100 200 300 400 500 MILES
SCALE 1: 20.000.000 315.66 MILES TO AN INCH
PROJECTION: ALBERS CONICAL EQUAL AREA
Thursday Is.
Ashmore Is.
DARWIN
Yirrkala
Weipa
Katherine
Wyndham
Cooktown
Cairns
Willis Is.
Derby
Broome
Halls Creek
Normanton
Tennant Creek
Camooweal
Townsville
Mt. Isa
Port Hedland
Hughenden
Mackay
Wittenoom Gorge
Alice Springs
Longreach
Rockhampton
Mundiwindi
Giles
Birdsville
Bundaberg
Carnarvon
Taroom
Wiluna
Charleville
Meekatharra
Oodnadatta
BRISBANE
Laverton
Marree
Geraldton
Moree
Grafton
Cook
Tarcoola
Bourke
Kalgoorlie
Eucla
Tamworth
Ceduna
Port Augusta
Dubbo
PERTH
Wagin
Mildura
Newcastle
SYDNEY
Esperance
ADELAIDE
Wollongong
Albany
CANBERRA
Horsham
Echuca
Cooma
MELBOURNE
Portland
Sale
Burnie
Launceston
Zeehan
HOBART
110
100
130
120
90
80
70
60
50
40
30
20

FIGURE 18

For comparative purposes of climatic conditions over the Australian Continent we include herewith copies of 3 special charts obtained from the Bureau of Meteorology:

FIGURE 16. Average Rainfall for Continent

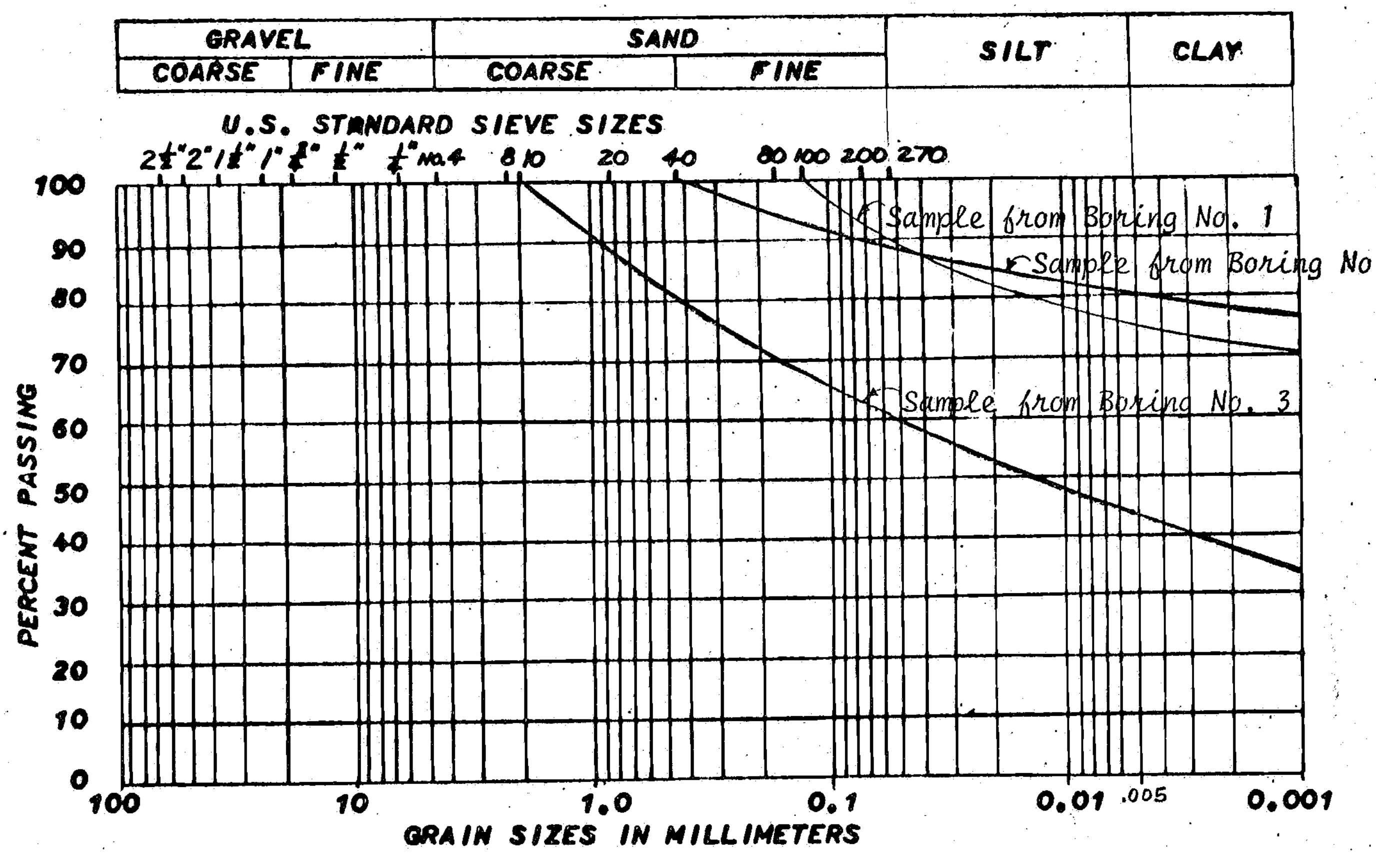
FIGURE 17. Monthly Distribution of Rainfall

FIGURE 18. Average Annual Evaporation

FINDINGS ON SOIL CONDITIONS.

The ground surface conditions of the potential salt production areas below Port Agusta, as shown in FIGURE 10 and as covered by this report, have been appropriately described in the Adam Report. Photo 36 shows another typical scene of the mud flats as they skirt the eastern margin of the potential land area.

Photo 36



GRAIN SIZE DISTRIBUTION CURVE

Boring No. from Which Sample was Taken	PERCENT SAND	PERCENT SILT	PERCENT CLAY	LIQUID LIMIT	PLASTIC INDEX	CLASSIFICATION
1 (6" Depth)	10	17	73	94.0	63	Clay
2 (6" Depth)	12	8	80	39.5	30	Clay
3 (12" Depth)	39	17	44	22.0	9.5	Sandy Clay & Silt

FIGURE 19.

BORING NOS 1,2,3

(AUSTRALIA)

CALDWELL, RICHARDS & SORENSEN, INC.

SOILS TESTING LABORATORY

PROJECT NO. 25-0673

9-69

Photo 37

A Post Hole Auger was
Used for Preliminary Sampling
to a Depth of about 3 Feet.

A following page contains a graph (Figure 19). This graph is the laboratory report on three samples of soil taken from places in the Point Paterson tidal basin. These samples are typical of nearly all of the mud flats that we examined from Port Pirie up to Point Paterson.

The locations from which these "near surface" samples were taken are shown on the map (Figure 11) (Drawing 6177 - Sheet 1).

Sample No. 1 was taken from the bare flats shown in the background of Photo 10. (See page 13a).

Samples Nos. 2 and 3 were taken from the foreground area of Photo No. 21. (See page 18).

All three of these samples contain some sand, some silt, but can be generally classified as "clay"soils.

You will observe from the laboratory reports that the percentage of clay in these samples varies from 44% to 80%. Particle sizes for clays lie below .005 mm., while particles of silt are larger than .005 mm. up to the size of fine sand.

High percentages of clay in most mixtures are usually an indication of relatively impervious soil.

Refer back to Photo 36. These lab reports are typical of the surface soils in the bare area of this photograph. A cursory field examination of the red-brown soils which predominate at the higher levels adjacent to these mud flats, as seen on the left hand side of said Photo 36, were found in most cases to be pure wind blown silt. These surface silts would not be as impervious, in themselves, as we need for efficient solar evaporation use, except for the deeper underlying clay strata, which may effectively hold the water after the ponds have come to maturity.

Refer back to page 10 of this report. Here is given the log of a typical deep test hole (Bore 53). You will note that the deep (below 13 feet) underlying material in these basins is impervious. We surmise that the designation "silt" on the deeper part of this log might be more properly classified as "clay" because of its impervious quality. However, fine silts can be made relatively impervious by proper mechanical tamping or surcharge loading.

20½ feet

We suggest, for a good description of the general character of the site that we are now discussing, that you read again the paragraphs on Page 10 titled "Ground Condition" and "Sub-surface".

PORT PIRIE LANDS NOT IN THIS STUDY

The known mud flats around Port Pirie were not investigated by us because of shallow water port facilities, but we have included a supplemental report on the "Salt Production Potential of Port Pirie" by C. M. Willington, Mining

Engineer, in Appendix No. 1 of our report. Said article was written in the year 1960 and we recommend that you read it because it conveys a well-worded description of many natural features of the Spencer Gulf easterly shore lands. This same description can be applied as also being typical of the Point Paterson and Area "C" lands, which we have visited and are here reporting on.

SUGGESTED PRELIMINARY PROJECT

Figure 20 consists of Drawing 6177 (Sheet 2) and shows a preliminary layout which we have made, utilizing the 10,000 acres selected between Mt. Grainger and Point Paterson, and the 2,600 acres selected for future supplemental solar evaporating ponds in Area "C" near Mt. Gullett.

Said drawing also shows the location of the proposed ship loading facility near Red Cliffs.

A preliminary layout of this kind is necessary in order to arrive at a rough estimate of the cost of the proposed project. The actual final design layout will depend upon much more detailed topographic data and a field testing program. It is our opinion that the sandy-clay soil predominating in this area will be suitable for the construction of dikes and embankment cores, but rock facing and gravel road surfacing will be needed to complete the dike construction.

Brief Statement of Operation. Primary Pump No. 1 would be installed at the original pump location on the big dike northeasterly from Point Paterson, and sea water would be pumped from the gulf into evaporating Pond #1. The brine would increase in density, progressively, and would be flowing, by gravity, through a series arrangement of Ponds #2, #3, and #4.

Pump No. 2 would be located at the strategic place, as shown, and would normally pump the process brine from Pond #4 into Ponds #5 and #5A. By having Pump #2 located at the intersection of five evaporating ponds, the flexibility provided to an operator is readily apparent.

Gravity flow is utilized for the balance of the operation through Evaporating Ponds #5, 5A, 6, 6A, and into the Brine Storage Ponds #7 and #7A.

C-1, C-2, C-3, and C-4 identify the proposed crystallizer ponds, where salt is precipitated during the months of September through April, and is harvested during the winter months of May through August.

You will observe on the plan (Figure 20) that a double dike, or canal, divides ponds #6 and #7, and also Ponds #6A and #C-2. This is a planned drainage ditch, which intercepts run-off water from the high land to the east and conveys it to the gulf via Chinaman Creek. There is a noticeable natural channel terminating in the mud flats at this location. (See Photo 38).

Photo 38.

Looking West across Area Reserved for Ponds #6, 6A, 7, 7A and C-1.
Runoff channel in Foreground and Chinaman Creek in Background.

Photo 39.

Aerial View looking East from a point about over Site of Proposed Central Stockpile Toward Reserved for Ponds #7, 7a, and Crystallizer C-3 & C-4

Washing, Stockpiling, and Loading. During our reconnaissance visit to the project area, we selected a site for the proposed central stockpile. This location is indicated on the drawing (Figure 20) and consists of a raised sandy area about 10 acres in size near Crystallizer #C-1, whose topography would lend it to an easy land-leveling job to prepare it for an excellent central stockpile area. (See Photo 39).

From the shore line, a few hundred feet away from the central stockpile area, it is only about 2 miles out into deep water (over 50 ft. depth) to a point near Middle Bank in the Spencer Gulf Channel, where a ship's berth is contemplated.

PRODUCTION CAPACITY CALCULATIONS

Based on 10 year record evaporation data obtained at Whyalla, we calculate that approximately 6-1/2 inches of monolithic salt will be precipitated in the proposed Crystallizer Ponds during the period September through April each year. (See Tabulation Figure 21).

The harvesting season would occur during May, June, July, and August, when the ponds would be relatively dormant.

You will observe from this tabulation that we estimate production capacity conservatively at 1,124 tons per acre per year for the crystallizers. This figure is in line with the information given us at the B.H.P. Whyalla Salt Plant. Mr. Havelberg, the Plant Superintendent, told us that he is getting from 6" to 8" of salt per year, and from 1,200 to 1,500 tons per acre per year.

Tons/acre in
178

200 - 188

Our proposed plan, shown on the map (Figure 20) provides for at least 1,000 acres of crystallizers (C-1, C-2, C-3, and C-4). At 1124 Tons/acre, the design capacity of the new plant would be 1,124,000 tons production annually, so we will use the figure of one-million tons as a realistic estimate. (i.e. 89% of 1124 ...

SOLAR EVAPORATION DESIGN DATA FOR ESTIMATING SALT YIELD AT RED CLIFF PROJECT

Rain	MONTH	NET EVAPORATION FROM * FRESH WATER PAN	NET EVAPORATION FROM OPEN POND * SATURATED BRINE	ESTIMATED ⊙ NOMINAL DEPTH OF SALT PRECIPITATED	ESTIMATED + SALT YIELD TONS PER ACRE
1.00	JULY	1.57"	0.77"	0.154"	----
.71	AUGUST	2.72"	1.33"	0.266"	----
1.16	SEPT.	3.60"	1.76"	0.352"	70.4
.86	OCT.	6.09"	2.98"	0.596"	119.2
1.00	NOV.	7.53"	3.69"	0.738"	147.6
[illegible]	DEC.	9.23"	4.52"	0.904"	180.8
.60	JAN.	10.40"	5.10"	1.020"	204.0
.75	FEB.	8.34"	4.08"	0.816"	163.2
.63	MARCH	7.44"	3.65"	0.730"	146.0
1.22	APRIL	4.73"	2.32"	0.464"	92.8
.80	MAY	2.77"	1.36"	0.272"	----
.79	JUNE	2.19"	1.07"	0.214"	----
10.22	ANNUAL TOTAL	66.61"	32.63"	6.526"	1,124.0 Tons/Acre for crystalizer Ponds

* From 10 year private record from B.H.P. Salt Plant at Whyalla

* evidently calculated at 49% of * but if rainfall considered however figures are 69-32%

⊙ evidently calculated @ 1/5" salt for 1" Net Evap for Brine

+ evidently calculated @ 200 tons salt for 1" of salt precipitated

FIGURE 21.

If all the land outlined on the maps (Figure 11 and Figure 20) is utilized, then the ratio of the total evaporating and brine storage pond areas to the crystallizer areas will be 8,600 to 1,000. It would appear that this ratio of 8.6:1 will be adequate for producing 1,000,000 tons of salt annually when the new ponds come to maturity.

USE OF AREA "C" NEAR MT. GULLETT

We have outlined on the maps (both Figure 11 and Figure 20) a supplemental 2,600 acre evaporating area separated from the Red Cliff Crystallizing Ponds C-3 and C-4 by about 2 miles.

Mt. Grainger rises above the shore line of Spencer Gulf at this location, but it would not be a barrier to a future road connecting the two complimenting projects, or to a future pipeline, or lined canal, for conveying concentrated brine from the north end of the 2600 acre addition to brine to Storage Pond #7.

Such a canal would have to be about 4 miles long, whereas a road to the central stockpile would be about 6 miles long, if salt were to be harvested in small crystallizers east of Yatala Harbour and trucked to the central stockpile.

Utilization of Area "C" would add an additional 250,000 tons production capacity to the initial plant. If ponds #7 and #7A were to be operated as additional crystallizers, the entire 2600 acres of Area "C" might be utilized for concentrating ponds, adding the extra 1/4 million tons for harvesting each year in the crystallizers adjacent to the Red Cliff central stockpile area. Therefore, utilizing Area "C" near Mt. Gullett would enable a total annual production at this integrated site in the neighborhood of 1-1/4 million long tons.

PURITY REQUIREMENTS

A large percentage of the salt, as now sold on the world market, is used for chemical purposes, primarily for the production of chlorine and caustic

Photo 41

Aerial Photo showing Mt. Gullett - looking southeasterly. The land in foreground and center of picture is the extreme south end of the 2,600 acre Area "C" designated for possible supplemental solar evaporating use.

soda in the great industrial centers. Unfortunately, this very "low price" bulk commodity must comply with a relatively stringent high purity specification. Following is a typical specification for chemical grade salt, as established by the industry. Shipments below this specification are normally subject to a deduction from the contract price based on umpire sampling at the point of delivery:

Dry Basis Analysis Specification

NaCl	Not less than	99.0%
Sulfate (as SO_3)	Not more than	0.40%
Calcium (as Ca)	Not more than	0.13%
Calcium (as CaO)	Not more than	0.18%
Calcium (as $CaSO_4$)	Not more than	0.44%
Magnesium (as Mg)	Not more than	0.12%
Magnesium (as Mg O)	Not more than	0.20%
Magnesium (as $MgCl_2$)	Not more than	0.48%
Magnesium (or Mg SO_4)	Not more than	0.48%

The purity of salt is of paramount importance when dealing on the world market, and we deem it essential that you provide "modern" washing facilities by which all of your harvested salt should be processed prior to stockpiling.

It is impractical to try to wash salt after it has been stockpiled and set for a period of time, or prior to the ship loading.

Referring to pages 9 and 10, earlier in this report, you will see that none of the salt previously reported, as having been produced at Whyalla or at Augusta Salt (the Hooker project), would fully meet this general specification.

HARVESTING, WASHING & STOCKPILING

Modern ways of harvesting, washing, and stockpiling salt have reduced the cost of these processes to a minimum.

Harvesting is now done with a single machine. Two operators excavate and load salt from the crystallizing ponds during the harvesting season into a fleet of waiting trucks at the rate of up to 1,000 tons per hour. It may take only

This mile-long steel-and-concrete conveyor bridge is the final link to a huge magnetite orebody 53 miles inland. The shiploading facility was awarded first prize for engineering excellence by the New York Association of Consulting Engineers, and is an honor award winner in national Consulting Engineers Council competition.

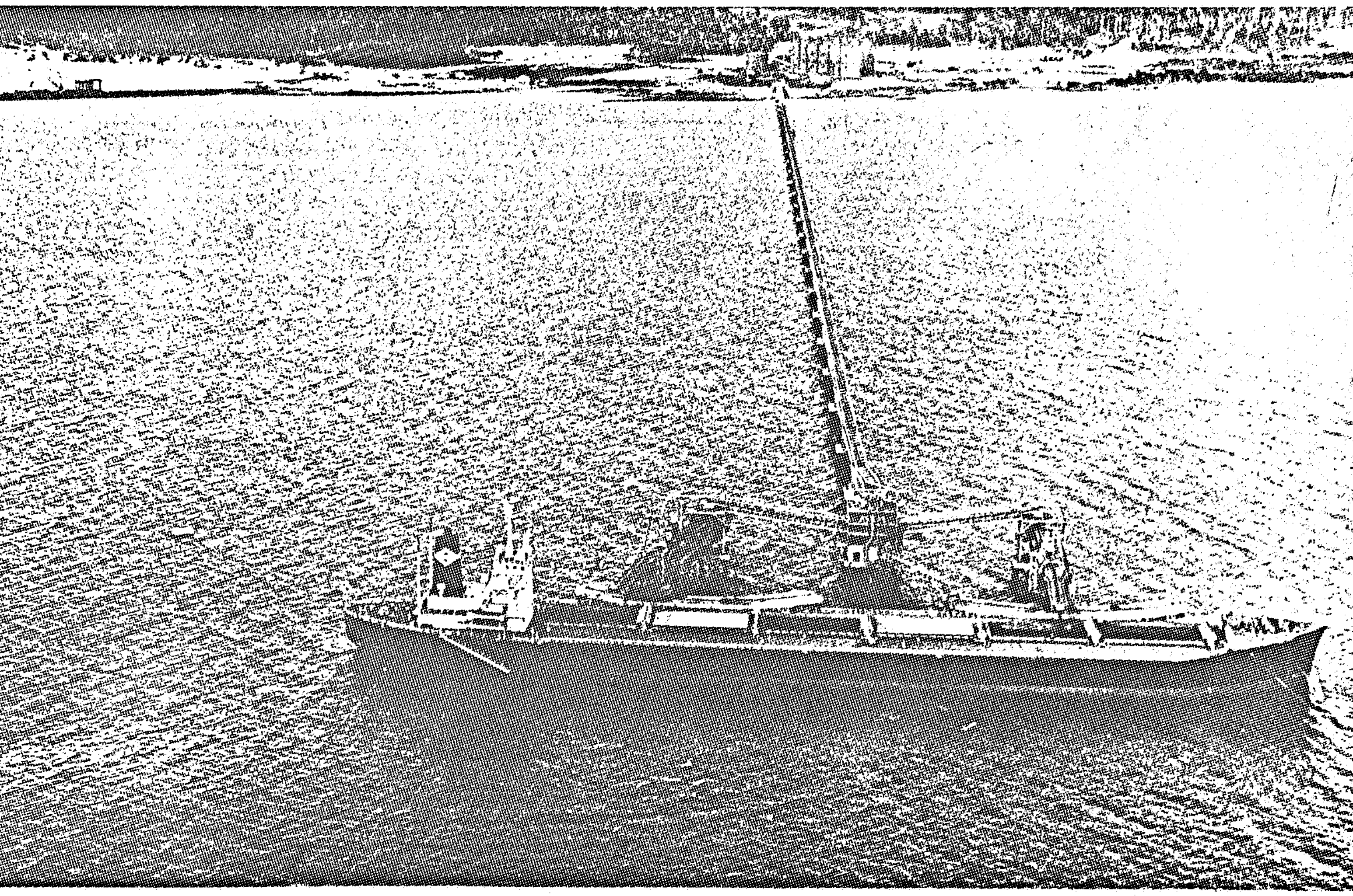


Photo 42

Ore-loading complex at Port Latta, Tasmania, showing a 105,000 ton displacement vessel being loaded. It is proposed to use a similar arrangement for salt at Red Cliff.

50 (round-the-clock-20 hour) days to harvest and wash 1,000,000 long tons of salt. This means the job may easily be done during a period of two winter months when the evaporating ponds are relatively dormant.

Washing is done by dumping the harvested and transported salt into a hopper from which it is fed in a thin 2" sheet on top of a "wire mesh" conveyor belt. Strong sprays of high density, good quality, salt brine are directed downward from the top, and these sprays scrub each particle of salt in a turbulant action. Dirt and unwanted chemicals, including a very small amount of very fine salt, are washed out and delivered to the brine clarification and recirculation tanks. The washed salt is de-watered on the wire mesh conveyor belt and is stockpiled in large trapezoidal cross-section stockpiles by modern materials handling conveyor systems.

BULK SHIP LOADING FACILITIES

Referring to pages 11 and 12 earlier in this report, the Point Paterson and Red Cliff schemes for loading ships are ably described therein.

We have verified that an 11,000 ft. long causeway conveyor system can be employed for ship loading large ships from the proposed Red Cliff central stock-pile site, and it has been suggested that this would be built at government expense.

A similar, though larger, installation was constructed at Port Latta, Tasmania, as shown in Photo 42.

The location for such a facility is shown on the map (Figure 20) (Drawing 6177, Sheet 2).

PRELIMINARY COST REPORT

A rough, conservative estimate of cost of constructing the initial solar evaporation salt production complex for 1,000,000 long tons annual

Photo 40.

View looking Southwesterly from Red Cliffs toward Middle Bank, where it is Proposed to Construct Ship Loading Facility. Photo Taken at Low Tide.

production at this site, not including land acquisition, employee housing, or ship loading facilities, is as follows:

4,000 ft. of Major Dikes @ $51.00 per ft.	=	$ 204,000
12 miles 64,000 ft. of Heavy Dikes @ $20.00 per ft.	=	1,380,000 +70% =
132,000 ft. of Standard Dikes @ $17.00/ft.	=	2,094,000
Pumps, control gates, roads & miscellaneous	=	322,000
Washing and stockpiling facilities for 1,000,000 long Tons/year	=	1,000,000

Total Preliminary Estimate $5,000,000
(Australian Dollars)

CONCLUSIONS

(1) Our reconnaissance study, which was based on a quick trip to the site and on the pertinent data which we were able to obtain, enables us to say that in our best judgment, a successful 1,250,000 long ton capacity solar evaporation salt project can be constructed and operated at the site examined, which extends from Point Paterson to Mt. Gullett. This would include a central stockpiling location and facility between Red Cliff Point and Red Cliffs.

(2) We believe the ship loading facility proposed for "Middle Bank" to be a feasible and economical solution to the shipping problem.

(3) We estimate that on a one million long ton initial scale of production, the capital unit outlay for construction will be approximately $A5.00/Ton, not including land acquisition, employee housing, or ship loading facilities. or
5 yrs @ 8% = 40% x $5 = $2.00

(4) We estimate that such a project will take at least one year for construction, and four years thereafter for operations to bring about a maturity of the brine, for the laying down of salt floors, and for the harvesting of the first crop of salt, before shipment can be realized. Full production and shipping may be expected thereafter.

(5) We estimate that on the initial 1,000,000 tons per year scale of operations, production costs will be approximately $A2.00 per ton of washed salt in the stockpile. This will include about 50¢ per ton for depreciation and amortization of the plant and not over $1.50 for costs of production, harvesting, transportation to central area, washing, and stockpiling.

(6) There appears to be about 9,640 acres of land surrounding Port Pirie which may be usable for salt production. This area was discussed by Mr. C. M. Willington, Mining Engineer, in a paper in 1960 (See Appendix No. 1). We did not visit this site and have not given consideration to it in this report because the construction of harbour facilities for large carriers would be more difficult. Port Pirie is now only suitable for ships loading about 13,000 tons of cargo, and deep water is about six miles offshore, as compared with deep water 2 miles offshore at Red Cliffs. The Port Pirie area, however, might be a potential site for primary evaporation of sea water preliminary to producing another 1,000,000 tons of salt. In such event the concentrated brine would have to be conveyed by pipeline or open canal, a distance of about 20 miles, to the Mt. Gullett ponds where it would join the other brines and end up in the Red Cliffs crystallizers.

RECOMMENDATIONS

If the figure of one-and-one quarter million long tons annual production of salt is adequate for your purpose and you desire to go ahead with this project, you then should proceed immediately to do the following:

(a) We recommend that you prepare an accurate topographic map on a scale of at least 500 feet to the inch for this entire site (approximately 14,000 acres, including Area "C" near Mt. Gullett) for use in the final planning of this project. This can be done by modern aerial methods and it may later be required to use these same flight photographs to prepare more detailed topography at a scale of 1" = 200 ft. in the areas selected for crystallizing ponds and special plant facilities.

(Note: These topographic maps may cost more than $35,000 -- our estimate in U. S.)

(b) We recommend that you take the necessary steps to acquire the land. This will include an application to the South Australian Government for a 21 ? year Special Mining Lease, in which your next 2 year program must be explained. Said lease should be renewable at the end of 21 years, and may include biannual reports to the State on the salt sold. It also would likely have a provision that a royalty of approximately 2-1/2% on net income is payable to the state. This would be in addition to payments for use of the ship loading facility, which would have been provided at government expense.

(c) We recommend that you conduct some additional soil tests and perform some field experiments (consisting of building and operating some small test ponds, etc.) prior to designing the final project. We would be willing to undertake this assignment -- to be done with South Australia personnel under our direction from the U. S. This work could be planned to a small nominal budget.

October 10, 1969
Salt Lake City, Utah

CALDWELL, RICHARDS & SORENSEN, INC.
Consulting Civil Engineers

ADDENDUM NO. 1

SALT PRODUCTION POTENTIAL - PORT PIRIE.

By C. M. Willington, Mining Engineer

INTRODUCTION

East and West of the town of Port Pirie are very large areas of tidal flats adjoining the coast line, which topographically and geographically are ideally suited to the production of salt by solar evaporation of sea water. The flats, however, are penetrated by tidal creeks, which would considerably affect utilization of portions of the areas for primary evaporation purposes.

A reconnaissance was made on June 28th and 29th by motor vehicle, traversing as much of both areas as possible in an endeavour to assess the extent of the flat areas inland from permanent tidal creeks.

WESTERN AREA.

The area examined comprised Sections 1092, 1093 adjoining Pt. Davis Creek, Sections J and I adjoining Fisherman's Creek, Sections H. F. and 999 adjoining third fourth and fifth creeks, section 968 adjoining second creek, section 1069 adjoining first creek, and sections 968 and 954.

This area, together with a large portion of land, within the town boundary from Section 416 in the S. W. corner to Section 752 in the N. E. corner is under Reservation from the Mining Act.

The total section area excluding that within the town boundary is approximately 28 square miles or 18,000 acres. Much of this land, however, for approximately 1-1/2 miles inland from the mangrove coast line is an intricate net-work of tidal creeks, which could not be economically utilized for primary evaporating areas.

The remainder of the area inland from the heads of the principal creeks, sparsely traversed by minor creeks, and extending to the Southern and Eastern boundary of the area under reservation is estimated as follows:

SECTION	USEABLE AREA IN ACRES.
1093	1,600
1092	1,440
J	Nil
I	1,080
H	1,120
999	960
F	640
954	1,280
968	720
1069	800
Total	9,640 acres.

Under the local climatic conditions at Port Pirie with a nett evaporation rate of 60 inches per annum, and a sea water salinity of 8.0 ozs. total salts per gallon, a yield of at least 100 tons per acre per annum from primary evaporation areas could be expected.

TIDAL CONDITIONS:

The following observations relating to tidal conditions in the creeks, and on the tidal flats were given by Mr. Ray Wearn of the Pirie Chemical Treatment plant. Mr. Wearn is quite familiar with the area.

At Port Davis, Section 814, the creek is 100 yards in width, and three to four feet deep at low tide, and 12 to 14 feet deep at high tide.

There is a small jetty at Port Davis, and fishing boats of 3' to 4' draft are regularly moored in the creek.

At the head of Third Creek, Section F, one mile from the coast there is 1'6" of water in the creek at low tide, and 10' of water at high tide. The tide on occasion rises 3' higher than the creek banks at this point, and flood inland for almost half a mile.

Similar tide conditions prevail at the heads of the other creeks.

On rare occasions during a 12 foot tide, and certain wind conditions, tide water extends inland as far as the Pirie Chemical Treatment Plant, residue dams, i.e. into the S. E. corner of Section 1069.

At the head of First Creek, Section 1069, one mile inland, is a shallow tidal lagoon, some 200 acres in area, and used as a motor cycle speedway during the summer. This area, if sealed off from tidal ingress might well serve as one observation or test area, to determine seepage and evaporation data.

TESTING RECOMMENDATIONS:

Observations to date have been of a reconnaissance nature only. For a closer preliminary appraisal it would be necessary to make a contour survey of the area to plan for suitable evaporation and crystalliser areas; observe tidal fluctuations and inundations, and construct a number of pilot evaporation pans to determine seepage and evaporation data. As an aid to seepage determination it would also be desirable to sink a number of test pits, or auger holes to examine the nature of the underlying strata for brine holding capacity. Material from the pits or holes to be examined for permeability.

EASTERN AREA.

The area examined East of the town of Port Pirie comprises Sections AW,966, 991, 368, 1055, B, 813 and 812 and totals approximately 5,000 acres.

Practically the whole of Sections B, 813, and 812, and the seaward side of these sections, is mangrove swamp with an intricate maze of tidal creeks which would require an enormous amount of preparatory and development work for use as a solar evaporation area.

ADDENDUM NO. 2

BRIEF HISTORY OF THE SALT INDUSTRY - PORT PATERSON AREA

By J. R. Adam, Mineral Development Engineer

John Saeck took interest in salt production near Port Augusta in November, 1950 and obtained a Special Mining Lease of about five thousand acres of sections 1068G, 1068H and 1083 of Hundred of Davenport in January 1951, converting it to Miscellaneous Salt Leases (567 to 576, inclusive, in April 1952). By June 1952, J. Saeck had spent about 25,000 pounds sterling on the project; he also had obtained a Special Mining Lease on 11,000 acres to the south.

In July, 1952 Solar Salt Ltd. (nominal capital 500,000 pounds sterling) a subsidiary of Mainguard (Aust.) Ltd., of Sydney was formed to work J. Saeck's leases. Mainguard Ltd. provided 85,000 pounds sterling to establish the salt works and anticipated being able to develop large scale production. The Department of Mines and the Engineering and Water Supply Department assisted with numerous inspections, tests and reports, and continually advised Mr. P. Cullen, a Director of Mainguard Ltd. that an expenditure of 2 - 2-1/2 million pounds sterling would probably be needed to establish a production of 200,000 tons of salt per annum, and thorough tests would be necessary of the suitability of the site, especially from the point of view of loss of salt by seepage.

In 1953, an approach was made for an agreement between the Harbors Board and Solar Salt on the installation of bulk loading port facilities, but the Director of Mines advised deferment of the decision, as the whole project "was regarded as very unassured at present".

In 1954, Mr. Betheras of the Department of Mines reported that proposals of J. O. Bovill of Mainguard Ltd. for Port Paterson production, appeared to be very exaggerated and untested.

In 1956 Mr. B. Peltz was made local Manager and salt production was got under way. The sales of salt by Solar Salt were:-

274 tons in	1957
3,723 tons in	1958
5,969 tons in	1959
7,036 tons in	1960
3,303 tons in	1961

Total 20,305. In the eight years that they held the lease.

In 1957 another approach was made to the S. A. Government for financial assistance of 400,000 pounds sterling to establish bulk loading facilities at Port Augusta as a contract for 600,000 tons of salt for Japan had been accepted at 21/- per ton f.o.b. Port Augusta. Evidence was given by the Mines Department that the price was not realistic and the project did not appear economic.

In April, 1961 Augusta Salt Ltd. was formed by Hooker Projects Pty. Ltd. (formerly Mainguard Aust. Ltd.) and J. Saeck with nominal capital of 500,000 pounds sterling and capital of 50,000 pounds sterling half contributed by each party, to develop the salt leases of J. Saeck, and the interests previously controlled by Solar Salt Ltd. Mr. W. J. Smith, of Hooker Projects, was made Managing Director and Sir William Bishop was nominated as Chairman by the Honourable the Premier of South Australia. A debenture over the cost for assets of 180,000 pounds sterling at 6% interest and repayment over 15 years was held L. J. Hooker Investment Corporation Ltd.

Since 1961 the salt leases Nos. 567 to 576 have been held by Augusta Salt Ltd. and the sales of salt have been:

7,977 tons in	1961
10,597 tons in	1962
6,608 tons in	1963
20 tons in	1964
44 tons in	1965 (half year)

25,246 tons total in four years.

Augusta Salt also held Special Mining Leases to the south of about 11,000 acres, from 1961 to 1964, but renewal was not granted in June 1964 because of the lack of progress. This area was reserved from the Mining Act in November, 1964.

Prior to 1965 the Company, now a wholly owned subsidiary of L. J. Hooker Investments Corporation Ltd., made arrangements with the previous government for the establishment of port facilities at the cost of 1,150,000 pounds sterling, provided certain guarantees were made. Similar arrangements were also promised by the present government under the same terms.

Suspension of labour conditions on the salt leases was granted on 23rd October, 1964 for the 1964-65 season, while negotiations with several Companies, including Lesley Salt Co. of San Francisco, to establish a large salt industry were being furthered. However, these negotiations broke down and on 24th February 1965 negotiations with Mitsubishi appear to have broken down also. Advice on 16th September indicated negotiations with I.C.I. were also turned down and Augusta Salt Ltd. was proposing to sell leases, etc. by public tender.

Labour Conditions

Under the present arrangement no labour need be used on the leases, other than for maintenance work until 15th January 1966 when the harvesting season should commence. Under the regulations of the Mining Act, the holder of a salt lease must employ at least one man for every 40 acres continuously (8 hours per day, Monday to Friday) gathering salt on leases during the months of January from the 15th, and February, March and April. (Every horse or horse-power of machinery employed is counted as two men). In the case of non-payment of rent or non-compliance with the labour conditions the government may exercise the power of cancellation, without giving written notice.

To comply with the labour conditions, Augusta Salt must employ 146 men or 73 horse-power continuously gathering salt from 15th January, 1965 to the end of April.

20/9/65

Shell grit deposits were observed on Sections 812 and 813, which means seepage rate would be high along the Eastern Boundary. The only area which appears reasonably attractive for solar evaporation of sea water is the Eastern portion of Section AW, and Section 966, an area of approximately 1200-1500 acres. Here again a detailed contour survey of the selected area would be necessary and soil testing undertaken to determine permeability. Although this area is much smaller than the Western area, it is much closer to a deep water loading site on the Port Pirie Channel and may be worthy of closer consideration from this aspect.

EMBANKMENTS.

The gypseous marl and sandy clay found on the tidal flats of both the Eastern and Western localities would be suitable for the construction of embankment cores, but would require rock capping and facing, to combat erosion from wave action. Suitable material would be available for this prupose from Mt. Ferguson, Section 1, Hundred of Telowie, ten miles north of Port Pirie.

CMW:PMT
12/7/60.