Open File Envelope No. 1082

SML 174

MOUNT CRAWFORD SILICA/KAOLIN DEPOSIT

MINING FEASIBILITY STUDY AND RELATED TECHNICAL APPRAISAL REPORTS FOR THE PERIOD 1/3/1968 TO 28/2/1970

Submitted by
Australian Blue Metal Pty Ltd
1970

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

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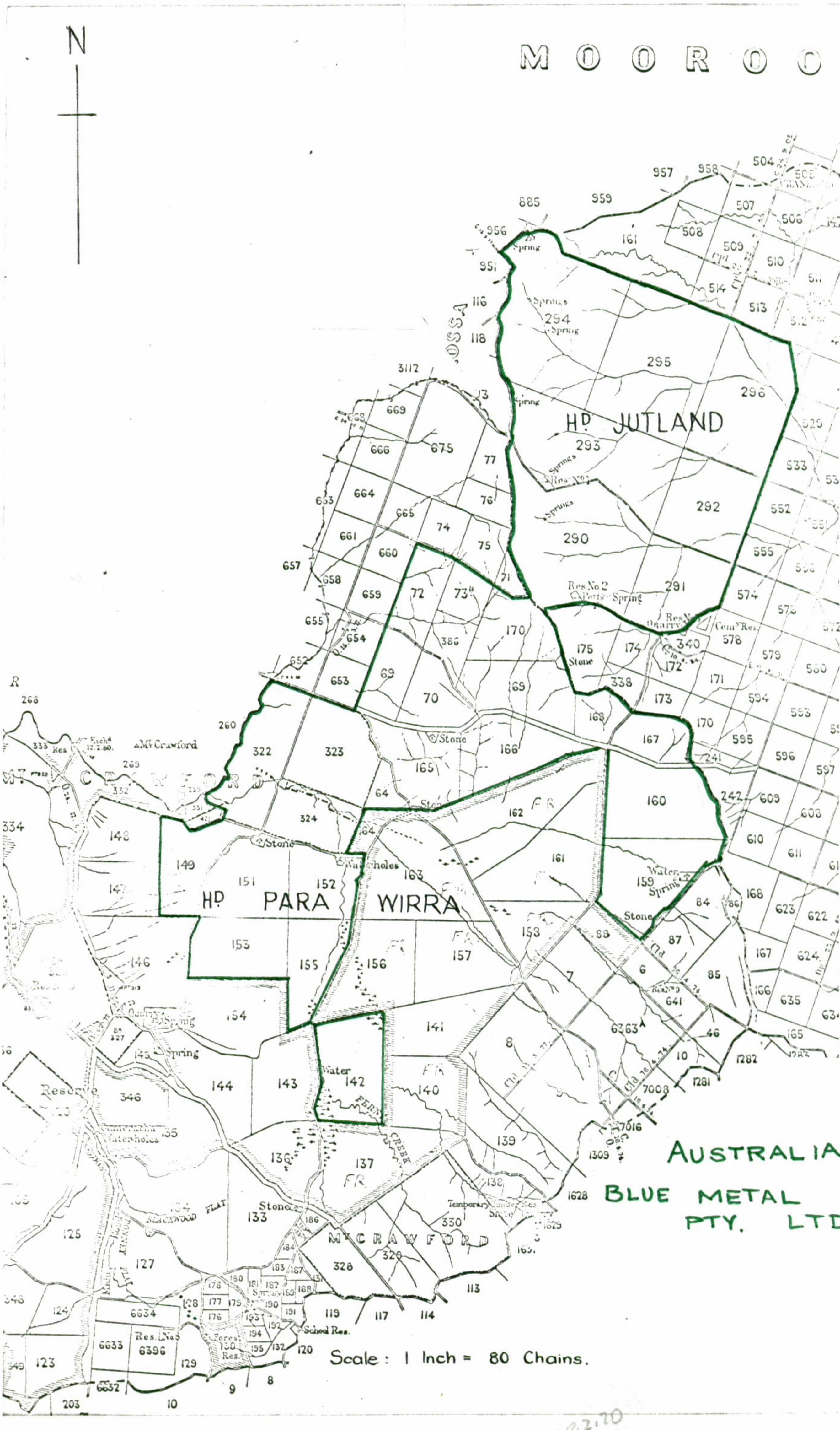
Government of South Australia
Primary Industries and Resources SA



AUSTRALIAN BLUE METAL PTY. LTD.

DM. 227/68

Exp 28.2.70

S.M.L. 174

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SHEET 4	"	"	"	"	(1082(3)-5)
SHEET 5	"	"	"	"	(1082(3)-2)
SHEET 6	"	"	"	"	(1082(3)-7)
SHEET 7	"	"	"	"	(1082(3)-8)
SHEET 8	"	"	"	"	(1082(3)-9)
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SHEET 10	"	"	"	"	(1082(3)-12)
SHEET 11	"	"	"	"	(1082(3)-10)

AUSTRALIAN BLUE METAL PTY. LTD.

82 EAST TERRACE, ADELAIDE

Office Phone 23 3366

an associate of THE READYMIX GROUP (S.A.)

Laboratory Phone 46 2211

MINERAL EXPLORATION — MINING — ASSAY LABORATORIES

006

MT. CRAWFORD SOUTH AUSTRALIA

KAOLIN/SILICA DEPOSIT

INVESTIGATION AND LOG OF BORES

Index.

CONYNGHAM ST. FREWVILLE SOUTH AUSTRALIA 5063 TELEPHONE 79 1662 TELEGRAMS 'AMDEL' ADELAIDE

007

THE AUSTRALIAN MINERAL DEVELOPMENT LABORATORIES

C/1

PLEASE ADDRESS ALL CORRESPONDENCE TO THE DIRECTOR.

OUR REFERENCE: AN3/115/2/0 - 2470/68
YOUR REFERENCE:

8th March, 1968

Mr P. Taylor,
Australian Blue Metals Pty, Ltd,
82 East Terrace,
ADELAIDE, S.A. 5001.

REPORT AN2470/68

YOUR REFERENCE:	Application dated 13/2/68
MATERIAL:	Sandstone
LOCALITY:	Mt Crawford
IDENTIFICATION:	Laboratory No. CE3337
DATE RECEIVED:	13/2/68

Enquiries quoting AN2470/68 to Officer in Charge please.

Analysis by: A.H. Jorgensen

Officer in Charge, Analytical Section: A.B. Timms

P.A. Young
Director.

kp:2

ANALYSIS
%

		CE3337 Original	CE3337 Washed
Silica	SiO_2	75.8	47.8
Aluminium oxide	Al_2O_3	14.7	37.0
Ferric oxide	Fe_2O_3	0.09	0.22
Ferrous oxide	FeO	0.22	0.18
Magnesium xoide	MgO	0.80	0.74
Calcium oxide	CaO	0.01	0.02
Manganese oxide	MnO	<0.01	<0.01
Sodium oxide	Na_2O	0.62	0.21
Potassium oxide	K_2O	0.01	0.01
Titanium oxide	TiO_2	0.32	0.08
Sulphur trioxide	SO_3	<0.01	<0.01
Chlorine	Cl	0.95	0.31
Carbonate	CO_2	0.02	0.01
Water over 100°C	H_2O+	6.55	13.5
Total		100.30	100.15
Less			
O ≡ Cl		0.21	0.07
		100.09	100.08

The above results are on a dry basis

CONYNGHAM ST. FREWVILLE SOUTH AUSTRALIA 5063 TELEPHONE 79 1662 TELEGRAMS "AMDEL" ADELAIDE

009

THE AUSTRALIAN MINERAL DEVELOPMENT LABORATORIES

PLEASE ADDRESS ALL CORRESPONDENCE TO THE DIRECTOR.

OUR REFERENCE: ML 3/1/5/2/3
YOUR REFERENCE:

27th May, 1968

Australian Blue Metal Pty. Ltd.,
82 East Terrace,
ADELAIDE, S.A. 5000

Attention: Mr. P. Taylor

REPORT ML 3605/68

YOUR REFERENCE: Application dated 22-5-68.

MATERIAL; Kaolin.

LOCALITY: Mt. Crawford.

DATE RECEIVED: 22-5-68.

WORK REQUIRED: Cyclosizing.

One sample of Mt. Crawford Kaolin was received for cyclosizing. The sample was dried to obtain a true weight and screened on a 200 mesh B.S. screen. A 50g sample of minus 200 mesh material taken and a cyclosizing carried out. The results are shown below.

Microns	Wt. %
+ 41.7	0.3
-41.7 + 31.0	1.2
-31.0 + 21.8	5.6
-21.8 + 14.2	9.5
-14.2 + 11.1	7.2
- 11.1	76.2
	100.0

Investigation and Report by: S. Armstrong.

Officer in Charge, Metallurgy Section: P.K. Hosking.

P.A. Young
Director.

THE AUSTRALIAN MINERAL DEVELOPMENT LABORATORIES

PLEASE ADDRESS ALL CORRESPONDENCE TO THE DIRECTOR.

OUR REFERENCE: CE 3/115/2/0
YOUR REFERENCE:

26th February, 1968

The Manager,
Australian Blue Metals Pty Ltd,
82, East Terrace,
ADELAIDE. 5000

REPORT CE 2424/68

YOUR REFERENCE:	Application dated 7/2/68		
IDENTIFICATION:	Marked:	1. S. 1 2. EX. 1 3. Mt Crawford 4. Feldspar	
DATE RECEIVED:		7/2/68	
WORK REQUIRED:	Samples	1.) 2.) 3. 4.	Pyrometric Cone Equivalent Dry and pulverise Fusion test
LABORATORY NUMBERS:	1. CE3332 2. CE3333 3. CE3334 4. CE3335		

Investigation by: T.M. Lennox

Officer in Charge, Ceramics Section: D.C. Madigan

D C Madigan
for P.A. Young
Director.

RESULTS

Samples 1 and 2

The samples marked S.1 and EX.1 were dried and pulverised. A representative sample of each was then prepared and tested according to the procedure set out in ASTM Designation C24-56, and the following results obtained:

Sample	Pyrometric Cone Equivalent
1. S.1	Below Cone 31 (Sample fused at approx. 1350°C)
2. EX.1	Cone 34 (1763°C) - Fused material was dark brown in colour

Sample 3 MT. CRAWFORD.

The sample of Mt Crawford sandstone was dried and then pulverised. The ground material (24 lb) was supplied to Mr P. Taylor for examination.

Sample 4 FELDSPAR

The material marked Feldspar was dried and then pulverised. A representative sample of this and Sample S.1 were then fired at 1360°C for 30 minutes. After firing the samples were found to be fused. The fused specimens were examined under a microscope, which revealed that the material marked Feldspar consisted of white crystalline grains (probably quartz) in a clear, glassy matrix, together with a few black particles of impurities. This material may be felspathic, but a chemical and mineralogical analysis would be necessary to establish its possible use in ceramics.

The fused material marked S.1 consisted of some white crystalline particles in a clear glassy matrix, and also contained a fairly high proportion of dark-coloured impurities. The material would be of no value in refractories.

CONYNGHAM ST, FREWVILLE SOUTH AUSTRALIA ... ADELAIDE

012

THE AUSTRALIAN MINERAL DEVELOPMENT LABORATORIES

PLEASE ADDRESS ALL CORRESPONDENCE TO THE DIRECTOR.

OUR REFERENCE: CE 3/115/2/0
YOUR REFERENCE:

23rd February, 1968

The Manager,
Australian Blue Metals Pty Ltd,
82, East Terrace,
ADELAIDE. 5000

REPORT CE 2470/68

YOUR REFERENCE:	Application dated 13/2/68
MATERIAL:	Sandstone
LOCALITY:	Mt Crawford
DATE RECEIVED:	13/2/68
WORK REQUIRED:	Separation of clay from sand. Chemical analysis of original sample and clay fraction. Reflectance tests on clay fraction.
LABORATORY NUMBER:	CE3337

Investigated by: B.J. Baskeyfield

Officer in Charge, Ceramics Section: D.C. Madigan

D.C. Madigan
for P.A. Young
Director.

MT CRAWFORD SANDSTONE

The sample was ground in an end-runner mill. Grinding was very easy. The ground sample was washed and screened on 200 mesh to separate the clay and sand fractions. The undersize was filter-pressed at 40-50 psi. The filter-cakes constituting the clay fraction were dried, ground to minus 18 mesh, and bagged for delivery. The sand fraction was dried and bagged.

Three 2 x 2 in. tiles were semi-dry pressed from the clay fraction. One tile was dried at 105°C, the other two were fired at 1200°C for 1 hour, and white light reflectance measurements were made, with magnesium carbonate as the standard (100%). The results were:

	Reflectance %
Unfired clay	86.0
Fired clay (1)	91.0
(2)	92.0

The chemical analysis has not yet been completed, but the results will be forwarded as soon as they are available.

CONYNGHAM ST. FREWVILLE SOUTH AUSTRALIA 5063 TELEPHONE 79 1602 TELEGRAMS "AMDEL" ADELAIDE

THE AUSTRALIAN MINERAL DEVELOPMENT LABORATORIES 014

PLEASE ADDRESS ALL CORRESPONDENCE TO THE DIRECTOR.

OUR REFERENCE: CD 3/115/2/5
YOUR REFERENCE:

13th February, 1968

The Manager,
Australian Blue Metals,
32 East Terrace,
ADELAIDE, S.A. 5000

Mt Crawford

REPORT CD 2448/68

YOUR REFERENCE: Application dated 9/2/68

MATERIAL: Kaolinised Sandstone

IDENTIFICATION: Marked Mt. Crawford

DATE RECEIVED: 9/2/68

WORK REQUIRED: (1) Pyrometric Cone Equivalent of raw material.
(2) " " " of clay fraction.

LABORATORY NUMBER: CD 3336.

Investigation by: T.M. Lennox

Officer in Charge, Ceramics Section: D.C. Madigan

D C Madigan

P.A. Young
Director.

EXAMINATION OF [illegible]

RESULTS

A representative sample of the material received was crushed, then dispersed in water and screened through a 200 mesh B.S. sieve. The minus 200 mesh clay fraction was dried, a sample of the dried clay and a portion of the original material were then prepared and tested according to the procedure set out in A.S.T.M. Designation C.24-56. The following results were obtained.

SAMPLE	PYROMETRIC CONE EQUIVALENT
(1) Original raw material	Below Cone 31 (material fused at approx. cone 27 (1640°C)
(2) Clay fraction	Cone 34 (1763°C)

After the test the cones were examined. The original raw material was white with some brown mottle. The clay fraction was white.

THE AUSTRALIAN MINERAL DEVELOPMENT LABORATORIES

016

PLEASE ADDRESS ALL CORRESPONDENCE TO THE DIRECTOR.

OUR REFERENCE: CE 3/115/0/0
YOUR REFERENCE:

7th February, 1968

Australian Blue Metals,
82, East Terrace,
ADELAIDE.

REPORT CE 2301/68

YOUR REFERENCE:	Application dated 24/1/68
MATERIAL:	Sandstone (MT. CRAWFORD ~~Mt Pleasant~~), Kaolin (Cromer)
DATE RECEIVED:	24/1/68
WORK REQUIRED:	Sandstone: Separation of clay fraction and preliminary firing test Kaolin: PCE
LAB. NOS.:	Sandstone: CE3328 Kaolin: CE3327

Investigation and Report by: B.J. Baskeyfield

Officer in Charge, Ceramics Section: D.C. Madigan

for P.A. Young
Director.

017

MT. C[illegible]' DEP[illegible] 1. "[illegible]" - kaolin

The material ground easily in the [illegible] runner mill. After washing and screening through a minus 300-mesh screen the clay was filter pressed at 40-50 psi.

The sand remaining after washing and screening was dried and weighed, and amounted to 53% of the total sample. This material was retained for further investigation.

The filter cakes were extruded not de-aired at a moisture content of 24.3%, a smooth plastic column being obtained. Test buttons were wire-cut from the extruded column. Specimens dried well without cracking or distortion.

Firing was conducted in the [illegible]-1200°C range in 50°C steps with soaking for ½ hour at each temperature. The results of shrinkage, firing behaviour and cold water absorption are shown in Table 1.

The filter-pressed cakes were also mixed to a slip to test castability. The clay cast exceptionally well in 5 minutes and left the mould cleanly after 20 minutes. The material is very promising, and could possibly be used in a blend for the production of tiles, earthenware, pottery and porcelain. It is therefore suggested that a larger batch of this material should be obtained and a more detailed investigation made of its use in whiteware.

This material compares favourably with Cornish clays and is remarkable for its fine white colour in the 1150-1200°C firing range.

"CROMER" DEPOSIT 2. KAOLIN

~~As requested by the Exploration Manager, Mr P. Taylor, a complete PCE determination was not made, but the sample was tested against Cone 31, according to the procedure set out in ASTM Designation C.24-56. The result of the test showed that the pyrometric cone equivalent of the sample was greater than Cone 31 (1683°C).~~

TABLE 1: FIRING TEST (Mr. Crawford Deposit)

°C	Linear Drying Shrinkage %	Linear Firing Shrinkage %	Total Linear Shrinkage %	24-hour cold-water Absorption %	Remarks
800	6.6	0.0	6.6	33.0	Off-white, soft
850	6.6	1.5	8.1	33.5	do.
900	6.6	2.0	8.6	39.0	"
950	6.6	4.0	10.6	36.6	Slightly harder
1000	6.6	5.0	11.6	36.3	Off-white, harder
1050	6.6	5.0	11.6	35.8	do.
1100	6.6	6.6	13.2	32.2	Off-white, much harder
1150	6.6	10.0	16.6	24.1	Very white, hard
1200	6.6	10.8	17.4	21.6	do.

CONYNGHAM ST. FREWVILLE SOUTH AUSTRALIA 5063 TELEPHONE 79 1662 TELEGRAMS 'AMDEL' ADELAIDE

THE AUSTRALIAN MINERAL DEVELOPMENT LABORATORIES

019

PLEASE ADDRESS ALL CORRESPONDENCE TO THE DIRECTOR.

OUR REFERENCE: CE 3/115/2/0
YOUR REFERENCE:

5th February, 1968

The Manager,
Australian Blue Metals Pty Ltd,
82, East Terrace,
ADELAIDE.

BIRDWOOD.

Centre of area
O is [illegible]
Other [illegible] near O

REPORT CE 2233/68

YOUR REFERENCE:		Application dated 17/1/68	
MATERIAL:		33 samples of kaolin from 2 drill holes marked CM and OLF 1 sample of kaolinised sandstone (Mt Crawford)	
DATE RECEIVED:		17/1/68	
WORK REQUIRED:	1.	Drill samples:	PCE ($\pm$ Cone 31) on selected samples.
	2	Sandstone:	Wet split at 200 mesh and PCE on clay fraction
LABORATORY NUMBERS:	1.	CM Samples:	CE3249-3272
	2.	OLF:	3273-3281
	3	Mt Crawford: (Sandstone"). No-1 Sample.	3248

Investigated by: T.M. Lennox

Officer in Charge, Ceramics Section: D.C. Madigan

D. C. Madigan
for P.A. Young
Director.

TESTING OF CLAY SAMPLES

1. CM Samples

The 24 samples received were examined, and a selection was made from various depths of the borehole. A total of ten samples was prepared and tested according to the procedure set out in ASTM Designation C.24-56, and the following results obtained:

Sample	Pyrometric Cone Equivalent	Fired Colour
6 ft- 9 ft	Greater than Cone 31(1683°C)	Brown
12 ft-15 ft	Cone 31(1683°C)	"
18 ft-21 ft	" "	"
24 ft-27 ft	" "	"
30 ft-33 ft	" "	Light brown
36 ft-29 ft	Greater than Cone 31	Grey
42 ft-45 ft	" " " "	"
48 ft-51 ft	Cone 31	"
54 ft-57 ft	Greater than Cone 31	Light brown
60 ft-63 ft	" " " "	Brown

2. OLF Samples

The 9 samples received were prepared and tested according to the procedure set out in ASTM Designation C.24-56. The following results were obtained:

Sample	Pyrometric Cone Equivalent	Fired Colour
9 ft-12 ft	Below Cone 31(1683°C)	Dark brown
12ft- 15 ft	Greater than Cone 31	Brown
15 ft-18 ft	" " " "	Light brown
18 ft-21 ft	Equal to Cone 31	" "
21 ft-24 ft	" " " "	Grey
24 ft-27 ft	" " " "	"
27 ft-30 ft	" " " "	Light brown
30 ft-33 ft	" " " "	" "
36 ft-39 ft	Below Cone 31	Dark brown

3. Kaolinised Sandstone (Mt Crawford No 1.)

The sample received was crushed and dried, a representative portion was dispersed in water, then washed through a 200 mesh BS screen.

+ 200 mesh BS fraction = 55.0% (silica)
- 200 mesh BS fraction = 45.0% (clay)

after removal of water

The minus 200 mesh clay fraction was allowed to settle, the excess water was drawn off, and the residual clay dried out on a plaster slab. The dried clay was tested according to the procedure set out in ASTM Designation C.24-56, and the following result obtained:

Sample	Pyrometric Cone Equivalent	Fired Colour
Mt Crawford	Greater than Cone 31 (1683°C)	White

CONYNGHAM ST. FREWVILLE SOUTH AUSTRALIA 5063 TELEPHONE 79 1662 TELEGRAMS 'AMDEL' ADELAIDE

THE AUSTRALIAN MINERAL DEVELOPMENT LABORATORIES

021

PLEASE ADDRESS ALL CORRESPONDENCE TO THE DIRECTOR.

OUR REFERENCE: ML 3/115/2/0
YOUR REFERENCE:

2nd September, 1968

The Manager,
Australian Blue Metals,
82 East Terrace,
ADELAIDE, S.A. 5000

montmorillonite clay

REPORT ML 484-69

YOUR REFERENCE:	Application dated 2nd August, 1968
MATERIAL:	Dry ground iron ore with and without clay addative
DATE RECEIVED:	7.8.68
WORK REQUIRED:	1. Pelletising of approx. 10 lbs of ground iron ore (-300 mesh) without clay addative. 2. Pelletising 10 lbs ground ore (-300 mesh) with clay addative (1% as stated) 3. Strength testing of green and dried pellets from 1 and 2.

Investigation and Report by: W.L. Fraser and H.L. D'Rozario

Officer in Charge, Metallurgy Section: P.K. Hosking

P.K. Hosking

P.A. Young,
Director.

1. PELLETISING

The two 10 lb lots of ground iron ore, one containing 1% clay (as stated) were received from the Ceramics Section. These were pelletised separately on a 24 inch diameter disc under the following conditions:-

Disc angle	45°
" speed	28 rpm
Lip height	4 in.

Both batches pelletised readily but the material was insufficient for obtaining products of ½ in average diameter and the finished pellets varied from 3/8 to ½ in. in size. The moisture contents of the green pellets were:-

Batch 1 (without clay)	8.0 %
Batch 2 (with 1% clay)	7.3%

The green pellets from each batch were sampled for compressive and drop testing all remaining products being handed over to the Ceramics Section.

2. TESTING

The green compressive strengths of 3/8 in. diameter pellets as determined by a Head Wrightson pellet tester were:-

Batch 1 - 1.30, 1.85, 1.45 lbs force
Batch 2 - 1.20, 1.10, 1.30 " "

Results of the standard 18 in. drop tests for the green pellets were:-

	No. of Drops to Fracture
Batch 1	3, 5, 7
Batch 2	11, 9, 8

Samples of the green pellets from each batch were oven dried at 105°C and shock dried by the Ceramics Section and the dried pellets delivered for compressive strength determinations. These were as follows:-

a) Compressive Strength of Ovendried Pellets (105°C)

	Pellet Diameter					
	3/8"	½"	½"	7/16"	7/16"	
Batch 1	2.85	4.6	4.05	-	-	) lbs force
Batch 2	-	-	-	2.25	2.30	)

(b) Compressive Strength of Shock Dried Pellets
(All Pellets approximately 5/16 inch dia.)

Batch 1	1.85	1.80	1.45
Batch 2	2.55	2.65	2.30

CONYNGHAM ST. FREWVILLE SOUTH AUSTRALIA 5063 TELEPHONE 79 1662 TELEGRAMS 'AMDEL' ADELAIDE

THE AUSTRALIAN MINERAL DEVELOPMENT LABORATORIES

024

PLEASE ADDRESS ALL CORRESPONDENCE TO THE DIRECTOR.

OUR REFERENCE: ML 3/115/2/0
YOUR REFERENCE:

25th October, 1968

The Manager,
Australian Blue Metals Pty Ltd,
82 East Terrace,
ADELAIDE, S.A. 5000

Montmorillonite clay.

REPORT ML 1055-69

YOUR REFERENCE:	Application No.606 dated 7th September, 1968
MATERIAL:	Two clay samples
IDENTIFICATION:	PL1 - coarse, PL1 - minus 200 mesh
DATE RECEIVED:	19.9.68
WORK REQUIRED:	Preliminary pelletising tests with iron ore to examine the suitability of the clay as a substitute for Wyoming Bentonite

Investigation and Report by: W.L. Fraser and H.L. D'Rozario

Officer in Charge, Metallurgy Section: P.K. Hosking

P.K. Hosking

D. Dixon
Acting Director.

1. PREPARATION OF IRON ORE

A 300 lb sample of an Australian iron ore (Fe 56%) was jaw, cone and rolls crushed and the product hammer milled to a suitable fineness for pelletising. The milled sample gave the following screen analysis.

Mesh B.S.S.	Cumulative Weight % Passing
12	99.95
16	99.05
22	97.15
30	95.10
44	92.10
60	88.60
85	85.05
120	75.55
170	64.50
240	55.20
350	46.70

The specific surface area of the milled ore was 2,670 sq cms/gm (Blaine).

Six samples of 30-40 lbs each were cut out from the milled ore and these were prepared for the test work as under:-

Sample No.1	as milled, no additive
" " 2	" " " "
" " 3	dry blended with 0.5% Wyoming Bentonite
" " 4	dry blended with 0.5% PL1-minus 200 mesh
" " 5	dry blended with 1.0% PL1-minus 200 mesh

2. PELLETISING

Pelletising tests were carried out on a 24 inch diameter disc with a 4 inch high rim. For all tests the ore was fed dry to the disc with water being added through an atomising nozzle to the material on the revolving disc.

Test 1. In this test a sample of the milled ore, without any additive, was used to determine operating conditions under which pellets of satisfactory size and physical properties could be continuously produced. These were as under:-

Disc angle	42° from horizontal
" speed	29 rpm
Feed rate	20 lbs per hour
Product size	3/8 to 5/8 in dia.

Approximately 10-15 lbs of pellets were continuously produced under the above conditions. The product was sampled for moisture and green strength determinations with the remaining material being sealed in plastic bags. Test results are shown in Table 1.

Test 2. The batch of dry blended ore containing 0.5% Wyoming Bentonite was pelletised under the same conditions as for Test 1 with the product being sampled for moisture and strength tests. Results are shown in Table 1.

Tests 3 and 4. The batches of dry blends containing 0.5% and 1.0% clay from Sample PL-1 minus 200 mesh were pelletised sampled and tested as for the previous batches. Results are shown in Table 1.

3. PELLET PROPERTIES

The green strength was measured immediately after eabh batch of pellets was produced; the ½ in. pellets being selected from the batch for compression and drop tests. These tests were repeated on the same size of product after oven drying at $90^{\circ}C$ for 17 hours.

A standard "Head Wrightson" green pellet tester with load cell and recorder was used for the compressive strength determinations. For the drop test the pellets were dropped repeatedly from a height of 18 inches onto a concrete surface.

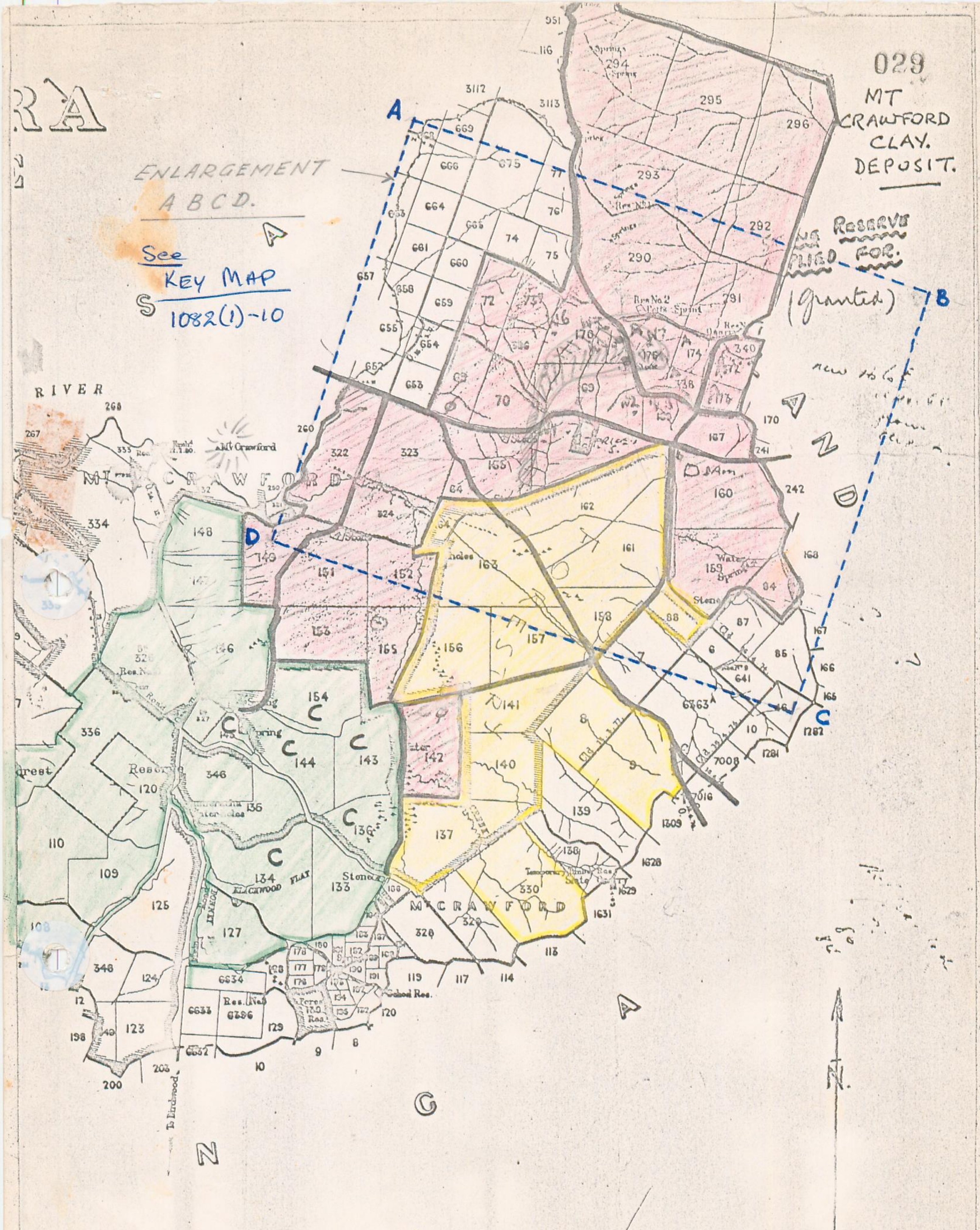
4. REMARKS

It will be noted that the iron ore available for use in this test work pelletised satisfactorily without any additive at the fineness to which it had been milled. However the results obtained show the sample of clay, PL1 - minus 200 mesh, to be similar to Wyoming Bentonite in its effects on the green and dry strengths of the balled ore, as almost equivalent increases of these properties were obtained for an addition of 0.5% of either of the two materials.

One important aspect of the evaluation which has not been considered in this investigation is effectiveness of binder during induration; that is, can the pellet withstand the temperature and thermal shocks developed during roasting. Amdel does not have equipment suitable for this type of evaluation.

TABLE 1: PHYSICAL PROPERTIES OF PELLETISED PRODUCTS

Pellet Composition	Green Pellet Moisture %	Green Pellets: Compressive Strength lbs	Green Pellets: Drop Test 18 in	Oven dried Pellets 90°C: Compressive Strength lbs	Oven dried Pellets 90°C: Drop Test 18 in.
1. Iron ore-no additive (½ in. dia.)	10.5	4.20, 4.40 6.15, 3.00 Mean 4.44	All pellets sustained 20 drops without fracture	13,40,11.70 11.70,13.30 12.10 Mean 12.4	3,2, 2,2, 2. Mean 2.2
2. Ore+ 0.5% Wyoming Bentonite (½ in. dia.)	11.1	7.85, 7.35 6.40, 7.05 6.65, 7.85 6.65, 8.85 Mean 7.33	As above	19.20, 20.40 21.20, 20.20 Mean 20.3	3, 3, 3, 2, 3, 5 Mean 3.2
3. Ore + 0.5% Clay PL1 (½")	10.6	6.75, 4.60 5.75, 7.30 5.75, 6.50 6.20, 7.95 Mean 6.35	As above	19.0, 21.2 19.0, 21.7 19.2 Mean 20.0	5, 3, 4, 3, 5 Mean 4.0
4. Ore + 1.0% Clay PL1 (½")	10.6	6.20, 6.35 7.10, 8.30 8.60, 7.70 6.65, 7.95 Mean, 7.35	As above	17.2, 23.3 18.0, 18.0 18.8, 23.3 Mean 19.8	3, 2, 2, 3, 3. Mean 2.6



— AUSTRALIAN BLUE METAL LTD. —

— 82 EAST TERRACE. —

— ADELAIDE. S.A. —

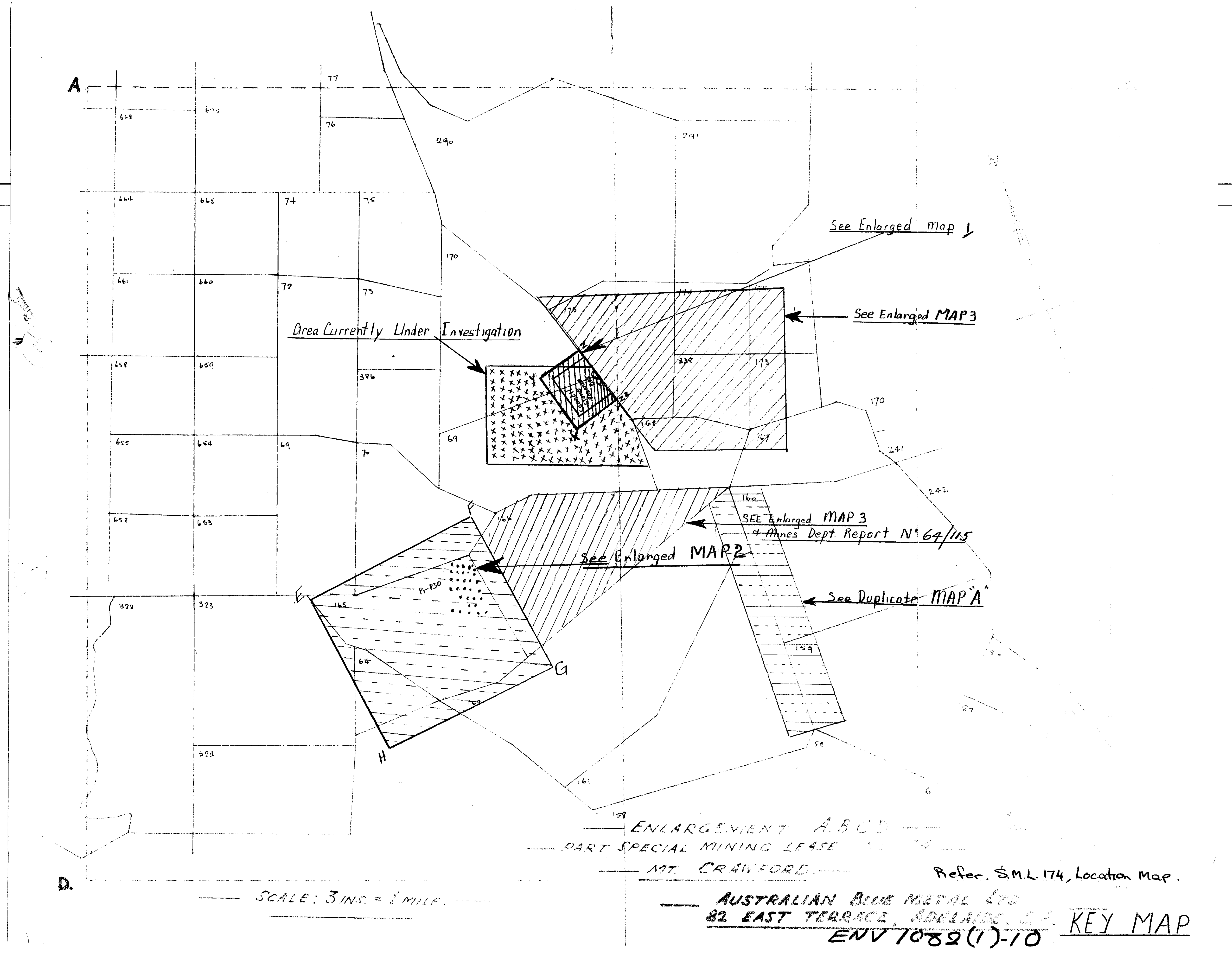
SCALE. 1" = 1 MILE.

GEOLOGICAL SKETCH MAP - MT. CRAWFORD AREA. refer:. to Plan

1082(1)-9

LEGEND.

a	Tertiary - clay, sand, etc. covered at least in part, by alluvium, outwash or soil, in areas of low relief.
b	Pegmatite (indicated by an abundance of quartz scree) associated with ? Tertiary clay and sand deposits.
c	Possibly Pegmatite associated with clay deposits in this area
d	Granite - gneiss
e	Kanmantoo Group (Cambrian) Micaceous sandstones, semi-schists and quartz-felspar schists and quartzites
---	Geological boundary - approximate only



A
D.
See Enlarged map 1
See Enlarged MAP 3
Area Currently Under Investigation
SEE Enlarged MAP 3
+ Mines Dept Report No 64/115
See Enlarged MAP 2
See Duplicate MAP "A"
P1-P30
E
G
H
N
290
291
170
ENLARGEMENT A.B.C.D
PART SPECIAL MINING LEASE
MT. CRAWFORD
SCALE: 3 INS. = 1 MILE.
Refer. S.M.L. 174, Location Map.
AUSTRALIAN BLUE METAL LTD.
82 EAST TERRACE, ADELAIDE, S.A.
ENV 1082(1)-10
KEY MAP

MT. CRAWFORD - KAOLINISED SAND DEPOSITS.

The area under lease lies to the east of Mt. Crawford in the Hundreds of Parra Wirra (Co. Adelaide) and Jutland (Co. Sturt) some 35 miles north-east of Adelaide.

1. GEOLOGY

1.1 Tertiary - clays and sands:

Sediments presumed to be of this age, occupy areas of low relief adjacent to the pegmatites which crop out in more elevated areas. These clays, sands and, in particular, the kaolinised sands, are also closely associated with the pegmatites which are almost certainly the source of the purer kaolinite clays.

In the low lying areas, more recent deposits of alluvium or outwash obscure the clays. Their presence at depths of up to 10 feet is revealed where earth dams have been sunk to depths greater than this. Both the lateral and vertical distribution of the clays and sands must be expected to be somewhat variable, as indeed must be the depth to basement rocks.

The vast quantities of clay were undoubtedly derived, in the main, from the pegmatites. The fine-grained quartz sand possibly owes its origin to the Kanmantoo Group sediments.

1.2 Pegmatite and associated clay deposits:

Much of the area is strewn with quartz scree which has been considered indicative of the presence at depth of pegmatites. ? Tertiary kaolinised sands are found in at least some of these areas. In Portion 169 (Parra Wirra) a small pit and a costean have cut into such material. Thin lenticular quartz veins up to at least 2" wide, cut through the kaolinised sands here. The almost pure white material here is composed of quartz and kaolinite. Any features suggestive of this material having been transported are conspicuous by their absence and it appears that this material has formed more or less in situ as a result of a comparatively lengthy period of weathering with which was associated a process of selective leaching and redeposition. Whereas in this pit (Portion 169) the resultant product is a quartz-kaolinite material, elsewhere either pure kaolinite or pure quartz sand have been encountered.

1.3 Granite-gneiss:

This rock type crops out boldly in areas adjacent to the indicated pegmatites. The clay deposits do not appear to be intimately associated with this rock type

1.4 Kanmantoo Group:

These sediments in general lie to the east of the Pegmatite-Clay deposits. They have an easterly dip and, in general, appear to mark the eastern limit of the clay deposits. In Portions 323 and 165 (Parra Wirra) weathered sediments crop out weakly on a low ridge. Numerous quartz pegmatite veins cut through these sediments and some clay deposits are present in this area.

In Portions 294 and 295 (Jutland) Pegmatite-clay deposits are possibly associated with the Kanmantoo Group sediments.

SUMMARY.

The area held under lease appears to contain very considerable quantities of kaolinite clay and fine quartz sand. The relative abundance of these two components will probably be somewhat variable and unpredictable. The sparsity of outcrop precludes the possibility of surface geological mapping being of great assistance in delineating the nature and extent of the deposits of clay and sand.

RECOMMENDATIONS.

1. That for purposes of relating and collating all available data, a base map be prepared from the available 40-chain Hundreds maps at a scale of about 10 chains to 1 inch, and that air-photo enlargements be obtained at a similar scale.

2. That the present drilling programme develop along more systematic lines with some continued geological direction by an appropriate local geological organization.

3. That tabulated core logs be prepared for all present and future bore holes in as great detail as is possible.

4. That the present auger drilling be supplemented with some more sophisticated drilling methods which will produce undisturbed samples.

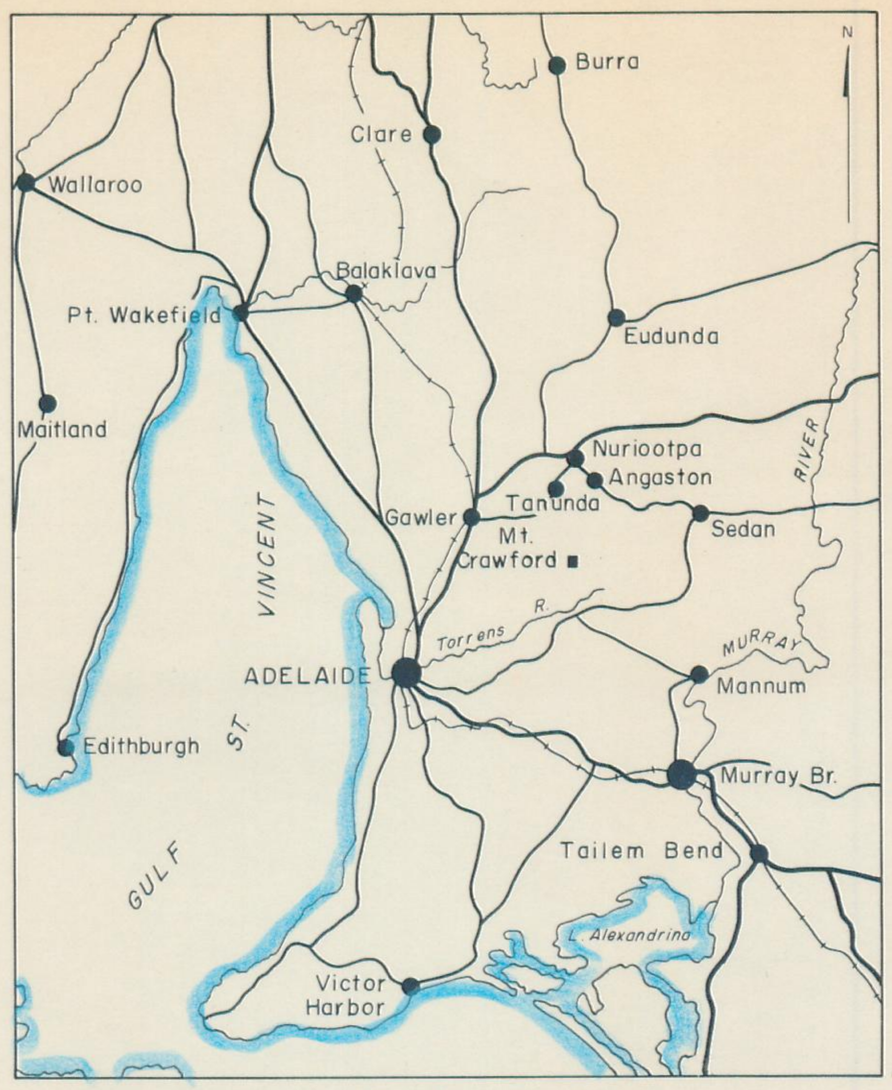
5. That a few of the more prospective areas be drilled to depths of up to 100 ft. or more in order that the depth of these deposits be known more precisely.

JOHN BRYAN.

RECONNAISSANCE GEOLOGY
MT. CRAWFORD
SOUTH AUSTRALIA

To accompany report by	Date:
Drawn by Geodrafting Services (N.S.W.) P.L.	Date Aug '68
Scale: 1/2 mile to one inch	PLATE

LOCATION MAP

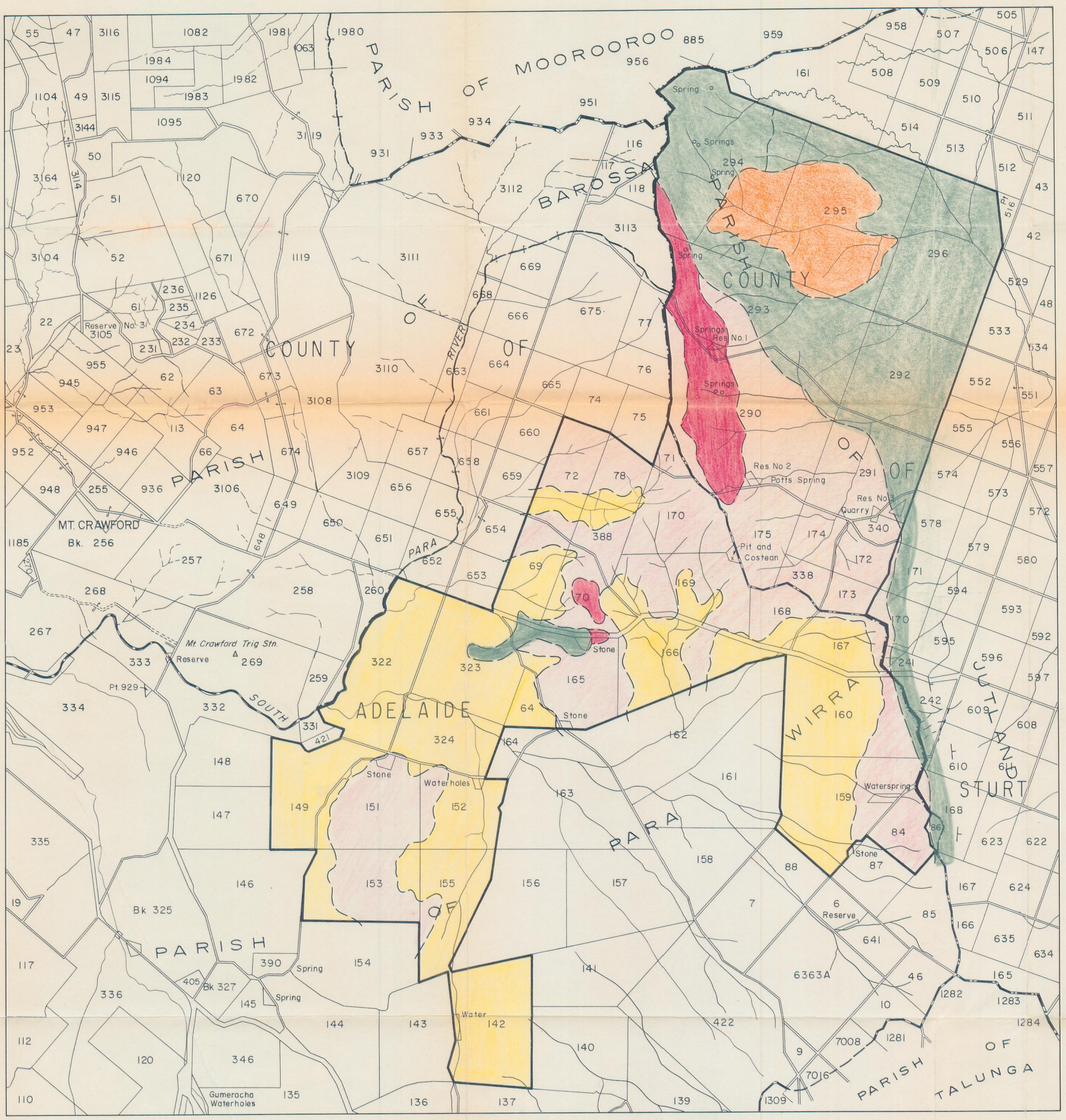


T.N.

SCALE

Chains 80 40 0 80 160 Chains

Miles 1 1/2 0 1 2 Miles



LEGEND

CAINOZOIC	a	Tertiary clay, sand and gravel overlain in part by Quarternary alluvium.
CAMBRIAN	b	Kanmantoo Group:- micaceous sandstone, semi schist, quartzite and schist.
UNDIFFERENTIATED MAINLY PRE-CAMBRIAN	c	Pegmatite associated with ? Tertiary clay and sand.
	d	Inferred pegmatite possibly associated with clay.
	e	Gneiss granite.

- - - Geological boundary – position approximate.

—— Lease boundary.

–·–·– County boundary.

– – – Parish boundary.

ENV 1082(1) - 9

Laboratories—
57 Todville Street
Woodville West
Telephone Nos.—
Offices: 23 6116
Depot & Laboratories: 45 4624
Telegrams—
"Geosurveys", Adelaide
Secretary—
Rennie F. Middleton,
F.A.S.A., A.C.A.A., J.P.

GEOSURVEYS
OF AUSTRALIA PTY. LIMITED
GEOLOGICAL AND GEOPHYSICAL CONSULTANTS

Managing Director: R. C. SPRIGG, M.Sc.
A.M.Aus.I.M.M., M.Am.A.P.G., M.G.S.Am.

Seventh Floor
DA COSTA BUILDING
GRENFELL STREET
ADELAIDE
SOUTH AUSTRALIA

G.P.O. BOX 1479 L

26th August, 1968.

RCS:HJR

033

Mr. A. W. Hardwicke,
Regional Manager,
Ready Mixed Concrete (S.A.) Pty. Limited,
82 East Terrace,
A D E L A I D E. SA.5000

Dear Mr. Hardwicke,

Preliminary Report on Mt. Crawford Clay Deposits

I am forwarding herewith several copies of a preliminary report stemming from my visit to the area in company with your Messrs. E. Taylor and M. Ives on Saturday, 24th August.

The report is self-explanatory, and you will see that I consider it essential that the northern open cut be deepened somewhat and extended slightly, and that another, and possibly two open cuts be made in the southernmost areas of present interest. It is essential that a good face be opened up in each case for reliable bulk sampling and provision of samples for testing. I have suggested that this data be extended by either shallow pitting and/or drilling at regular intervals to obtain deeper sequence of samples.

You will infer that I do not recommend taking shallow, intermediate and deep samples by bulking a group of auger drill cuttings. There are too many variables in this, and the results could well be misleading.

Assuming that the dozer cutting will be completed by mid-week, I will return from Brisbane in order to check out geological mapping of the faces by the end of the week. Our geological assistant, Mr. Anthony von Sanden will carry out the preliminary mapping in order to save time and costs.

Yours faithfully,
GEOSURVEYS OF AUSTRALIA PTY. LIMITED.

R. C. Sprigg,
Managing Director

RC Sprigg

c.c. Mr. A. T. von Sanden

Encl:

034

P R E L I M I N A R Y   R E P O R T   O N

M O U N T   C R A W F O R D   C L A Y   D E P O S I T S

by

R. C. Sprigg

GEOSURVEYS OF AUSTRALIA PTY. LTD.

August,1968.

An inspection of exploration operations in the Mt. Crawford area was made in company with Messrs. P. Taylor, M. Ives, and D. and A. von Sanden, on Saturday 24th August.

GEOLOGICAL FACTORS IN RELATION TO EXPLORATION

The area is one of ancient metasediments (altered sediments), deeply weathered and/or hydrothermally kaolinised with the development of varying vertical thicknesses of kaolinitic deposits. The weathering relates extensively to an ancient land surface and as such is a near surface phenomena. The older hydrothermal activity was however deep seated, and could extend downwards for thousands of feet.

Depending upon which of the foregoing processes dominated locally the vertical depth of the clayey formations, their compositional make up can vary within relatively wide ranges.

Factors likely to complicate tonnage estimations relate particularly to rapid lateral variations in the depth of alteration, to ferruginization (iron staining), irregularity of subsequent erosion, redeposition, etc.

EXPLORATION

Exploration techniques already applied to outlining potentially economic clay deposits have been valuable in determining preliminary areas of interest, and demonstrate the relatively wide - spread nature of the kaolin deposits. The probing has been carried out with the knowledge that more systematic sampling will follow in selected areas, and this is now essential to any field evaluation of the prospects.

THE BROAD CATEGORIES OF DEPOSITS

(a) Degraded lateritic and/or Silcrete fossil soil profiles

Much of the higher level deposits forming cappings to the land surface, appear at this time to be primarily ancient soil profiles. Weathering in the deeper B and C soil layers have typically caused leaching of the original altered slatey deposits (and intrusive pegmatites etc.) to whitish clays, these grading down vertical eventually into relatively unaltered bedrock. Preliminary auger drilling (20 - 40 feet) at this time has only infrequently encountered such substratum.

Typically in a soil profile such as this, either a silicified capping or a lateritic iron-stone layer overlies deeply kaolinised clay in a "pallid zone" grading below into a mottled ferruginised clayey zone and finally into parent rock. This type of formation appears well developed on Section 165 Hd. Para Wirra and is likely to be preserved in its deepest development on the tops of hills, nearest to the pre-existing high-level land surface. Auger drill holes have already sampled across one such plateau situation, but a deeper hole (possibly 60 - 100 feet deep) is needed to test the reliability of this tentative conclusion. More-over the full value of the clayey deposit in relation to probable dilutants such as patchy iron staining, quartz etc. is best tested by dozer cutting an east-west channel across the southerly nosing of the hill in this situation. Such cut should be extended downward, if possible, through to obvious economic cut-off (if encountered within reasonable depth), or otherwise opened at selected points by pitting.

It is important to note (and establish) that the laterization type process is essentially a sheet-process leading to formation of relatively shallow deposits, depending on the extent of weathering that has occurred. In the present case (Sections 165 and 166) the depth could be expected to extend mostly to about 40 feet with a considerable portion of the superficial material eventually having to be rejected as waste. The deeper sections generally can be extensively downgraded by pockety iron-staining requiring selective quarrying. Opening of respresentation faces is essential for a more satisfactory estimation of clay potential.

(b) "Pneumatolytic" or "hydrothermal" clay deposits

The Mt. Crawford area has produced a wide variety of clay deposits based on metamorphic processes of alteration. Some of these have been related to the introduction of beryl bearing pegmatites, others to concentrations of rutile, etc.

The foregoing processes are deep-seated and can carry down almost indefinitely. Vertical extensions of potential clay deposits of this type, then, are far more likely than in the foregoing "lateritic" class. Horizontal variation, on the other hand can be more rapid, and in fact quite sharp.

In the open cut on Section 170 it appears that some hydrothermal process has, in fact, been operative. The original sedimentary bedding stands almost vertical, and this gives indication that the intensity of alteration does vary from bed to bed, but all of the original felspathic and/or shaley minerals have been deeply kaolinised where observable. Residual materials appear to be almost entirely of quartz (original sand grains and subsequent veins).

This type of deposit is best evaluated in the early stages by costeaning by dozer cutting across the grain of the country (i.e. east-west), but this can be extended by vertical drill holes spaced at a fixed interval to reduce personal bias. In the present cut (which is well located) dozing should be used to deepen by at least another 10 feet, and in the floor of such cut, auger holes to an additional 40 feet will undoubtedly check out the potential and nature of the type of deposit.

FURTHER EXPLORATION AND SAMPLING

Additional drilling beyond this time should be directed to exploring tonnage potential away from the sample areas opening by costeaning. In this way the limitations of depth and/or lateral extention can be determined more systematically. A grid pattern possibly starting at 200 feet centres should next be considered with a view to subsequent infil as more promising areas are selected.

A broader pattern of auger drilling as previously carried out is excellent for scouting new areas, but early trial opening by dozer costeaning would be essential to methodical investigation prior to more detailed grid drilling.

TRIAL SAMPLING

Although kaolin deposits spread over a wide area in the exploration area, a considerable proportion is likely to prove shallow, or with poor overburden to recoverable clay relation, or spoiled by pockety staining. (This relates more for the lateritic type deposits). For this reason an open exposure is essential to permit meaningful sampling. Channel sampling across faces is essential, and this can be supplemented with vertical channel sampling, and the latter extended by drilling.

At this time at least two open cuts are required respectively in areas represented by the two principal types of deposits believed represented. The existing and/or proposed cuts on Sections 165 and 170 would be ideal. Each face is to be mapped geologically, and as to staining and other characters likely to effect mining or the end product. Thereafter the face must be channel sampled as by a 4 x 4 inch cut, the whole sample bulked in 5 foot intervals and quartered down to convenient size by competent authority. All material should be retained and carefully labelled, the duplicate sample in excess of immediate requirments being retained for future reference.

In each cut, vertical holes into the floor should be continued to obvious quality cut-off or potential quarrying limit. In fossil soil areas this may total less than 40 feet from the surface, but could be much deeper elsewhere. At this time it is better to over-drill, being careful to segregate samples into 3 to 5 foot lengths (depending on auger flights employed), and retaining all portions of the quartered samples.

REG C. SPRIGG

038

SUPPLEMENTARY REPORT ON

MOUNT CRAWFORD CLAY DEPOSITS

by

R. C. Sprigg

GEOSURVEYS OF AUSTRALIA PTY. LTD.

August, 1968.

In company with Messrs. D. & A. von Sanden and M. Ives, an inspection was made by the writer, of the Company's investigatory operations in progress, on 30th of August, 1968.

The limited new openings available for checking tended to confirm that a considerable proportion of the deposits so far located are lateritic in nature. In other words, the kaolinic clays are primarily fossil subsoil developments on an ancient land surface.

Insufficient progress had been made in deepening the east-west trench previously opened on Section 169 of Para Wirra, to permit channel sampling, associated drilling or geological mapping and preparation of engineering cross sections. The trenches on Section 166 were in the process of being dug. The trench on Section 165 was at a standstill. Sufficient information was, however, available to suggest the potential clay deposits in this zone are restricted in size, and represent a complicated open cutting proposition.

Progress to date appears definitely to be assigning potential clay deposits to the two categories previously predicted. For this reason the decision to investigate the laterized ridge extending north from Cromer "C" Clay Deposit was timely.

The north-south Cromer ridge extends into Special Mining Lease 174. The southern portions of this ridge contain a pneumatolytic zone of alteration and/or pegmatisation which has produced deep bodies of very white kaolin. This zone probably continues northerly, either unbroken or intermittently for at least another mile. A series of east-west aligned auger holes was recommended (and were commenced at the time) working north from the southern boundary of Section 153. In the event of localizing deep hydrothermal clay deposits a 'dozer cut is to be taken across the crown of the elongate rise carrying the clays. The general alignment of these deposits is clearly shown on the Gawler Map Sheet and should be followed by exploration.

Attempts to open cut a selection of the deposits should emphasize the absolute necessity of clean exposures of clay for visual inspection. Reliance solely on drilling is inordinately dangerous and can give very misleading results other than for preliminary scouting survey.

REG C. SPRIGG

Received by hand from Mr Clark 21-8-68. [illegible]

GEOSURVEYS OF AUSTRALIA PTY. LIMITED.

PRELIMINARY ASSESSMENT

CLAY SEARCH

SPECIAL MINING LEASE NO. 174 MT. CRAWFORD AREA.

AUSTRALIAN BLUE METALS PTY. LIMITED.

by

A.B. CLARK.

C O N T E N T S.

Special Mining Lease No. 174 held by Australian Blue Metal Limited is located east of Mt. Crawford within the Adelaide Hills. The area of about 22 square miles is known to all parties; access and mining location present no problems.

This initial assessment has been done without any consultation on the field work done by other parties.

HISTORICAL SUMMATION

1. EARLY CLAY PITS:

It is apparent that the pits have been worked in the first part by small family concerns with a gradual growth into companies. The writer has recently arrived in Adelaide and with the growth in the city of Adelaide, it is evident that the pits and quarries must grow in size and position.

2. CURRENT METHODS OF TESTING.

The Newbold Refractory Clay Pit at Birdwood is a deposit in the local area. A 15 feet clay bed has been exposed. In dry times, the pit would operate; in wet conditions the pit floor would hamper the operation, hence drainage has been an important operating aspect so that low lying areas have been avoided as sites.

In the area of S.M.L. 174 all the topographic forms must be investigated. The current investigations amount to about 40 holes bored by an air hammer. The immediate objection to this is that each hole requires a 10 ft. casing length so that any surface grit etc., does not contaminate the hole. The holes appear clustered in local areas with some line holes across the area.

GEOLOGY

1. REGIONAL

The area is within a succession of gneisses and schists which form part of the Kanmonto Group within the early Palaezoic. Recent alluvium and residual Tertiary deposits of clay and gravel mask the general outcrop pattern.

2. DETAIL.

The clay deposits can be divided into two types:-

(1) Hydrothermal kaolinisation - felspathisation of a bed.
(2) Clay bands association with quartz reefs, pegmatites and granite dyke bodies.

In type (1) the bed or beds appear restricted to the crown and shoulders of a ridge and type (2) has a general restriction from the ridge shoulders to the poorly drained areas.

The Tertiary deposits may have been transported from types (1) and (2). They were formed in a topographic environment which has altered to the present day. The original source could be within the poorly drained areas. It would not be unreasonable to expect that the most favourable areas would be in respect to the veined deposits. It is clear that the general distribution of types requires a greater degree of definition through a detail study.

WORK REQUIRED

The regional geological work completed by the Mines Department is sufficient for the moment. The emphasis must be placed upon the detail work.

The work required to define large deposits of clay and sand is as follows:-

(a) A systematic programme of holes gridded across the area. A minimum of 200 holes divided into a distribution of 4 lines each of 50 holes would test all the topographic forms. Each hole is to be collared and bored to a maximum depth of 100 feet. The total drill footage is 20,000 feet. The 40 holes completed will be assessed with the additional 200 holes.

(b) The use of a bulldozer to cut costeans for a total length of 2000 feet.

(c) Detail geological mapping is required on the costeans and on the correlation of results from the drill holes.

(d) The first stage of geological field investigations could be completed within 28 days.

CONCLUSIONS

The area has potential for the proving of large tonnages of clay and sand. To seek and ultimately to locate large clay and sand deposits, there is a genuine need to be systematic in the approach.

A.B. CLARK
Chief Mining Geologist.

R E P O R T   O N

T R E N C H I N G   I N V E S T I G A T I O N S

M O U N T   C R A W F O R D   C L A Y   D E P O S I T S

S. M. L. 174

by

R. C. Sprigg.

GEOSURVEYS OF AUSTRALIA PTY. LTD.

October, 1968

GEOLOGICAL PLANS TO ACCOMPANY MT. CRAWFORD CLAY INVESTIGATIONS

(Parishes Jutland and Para Wirra)

Four plans and/or cross sections have been prepared to summarise open cutting investigations completed at Mt. Crawford on behalf of Australian Blue Metal Pty. Ltd.

Plan Geo. 507	Locality Map S.M.L. 174.	
Geo. 510	Geological Section Plan	Trench No. 1
Geo. 511	Geological Section Plan	Trench No. 2
Geo. 512	Geological Section Plan	Trench No. 3

DESCRIPTION OF OPERATIONS

Three trenches opened on clay deposits located by auger drilling by Australian Blue Metal Pty. Ltd. are situated as follows:

Trench No. 1	Northern part of Section 166	Hd. Para Wirra
Trench No. 2	Near southern Boundary Section 166	Hd. Para Wirra
Trench No. 3	Across Boundary between Sections 170 and 169	Hd. Para Wirra

Full dimensions of these trenches are shown on the appropriate plans.

GENERAL REMARKS

All three openings have been excavated within deeply weathered and/or hydrothermally altered zones of Kanmantoo sandstones and schists. Kaolinization has been extensive, but mostly incomplete, for a number of felspathic, clayey and/or micaceous minerals. Where metasomatism (solution induced alteration) has been intense, an extensive reconstitution of the parent rock is indicated but not to the extent of destroying all pre-existing structure. Clay seams of relative high grade (?)Kaolin have been developed particularly in the northernmost prospect (Sections 169 - 170 Para Wirra). A complication has been introduced by deep secular weathering (incipient lateritic soil formation), and deposits of white clay in the immediate subsurface clay zone may grade below into impure clayey or gneissic developments carrying iron-stained pockets.

In the northern prospect, leaching has been extensive, leaving what appears to be relatively high quality granular quartz surrounded by clayey decompositional products, and intergranular rutile.

DETAILED DESCRIPTIONS

Trench No. 1: This inclined trench lies across the general strike of the Kanmantoo metasediments in which these deposits are developed. Bedding dips steeply to the east, and by the nature of the alteration, (? hydrothermal) somewhat less promising conditions can be expected to continue in depth.

The eastern half of the exposure consists of a deeply kaolinized schistose sandstone wherein much kaolin has been segregated into narrow high grade seams occupying fractures and former stress zones. The zone presents potential for kaolin clay and silica sand by physical methods of separation. A proportion of rutilic mineral would have to be removed in the event of development.

To the west the face is complicated by more sandy and/or schistose bands, the former of which carries concentrations of heavy mineral, principally rutile. Enriched kaolin occurs also in this sand but presumably would present a difficult and unattractive proposition for separation. Quartz seams are present. Still further to the west a more mixed situation exists, and the kaolinized zone is despoiled further by pocketty ferruginization.

The one auger hole put down at the east end of the trench bottomed in buff coloured clayey sandstone. Deeper drilling would be required to decide whether this was a deep weathering effect or reflecting less altered rock in depth.

Trench No. 2: The whole of this deposit has the appearance of being a deeply weathered soil profile developed in the Kanmantoo schistose sandstones. Steeply dipping beds appear to have facilitated formation of near vertical pockets of ferruginous (iron stained) material in a clayey sandstone matrix. Massive bodies of more ferruginous material tend to down-grade the clay content of deeper levels suggesting porosity control of leaching by processes of weathering.

Without extensive and costly treatment it would appear that the prospects for high grade clay recovery in this immediate vicinity are not promising.

Trench No. 3: This trench has been excavated in kaolinized sandstone wherein the proportion of silica sand dominates. The parent sediments dip steeply to eastward and have been deeply altered hydrothermally with the destruction of felspathic and micaceous minerals to kaolin. Rutile bands reflect original sedimentary bedding. Segregations of clay and ilmentic bands reveal a degree of re-constitution of the original mineral. Quartz veins, mostly of clear to milky white quartz are present. Ferruginization is limited and generally the beds constitute accumulations of silica sand and clay. However a proportion of mica is present, and the origin of the greyish colour (? original) is not clear.

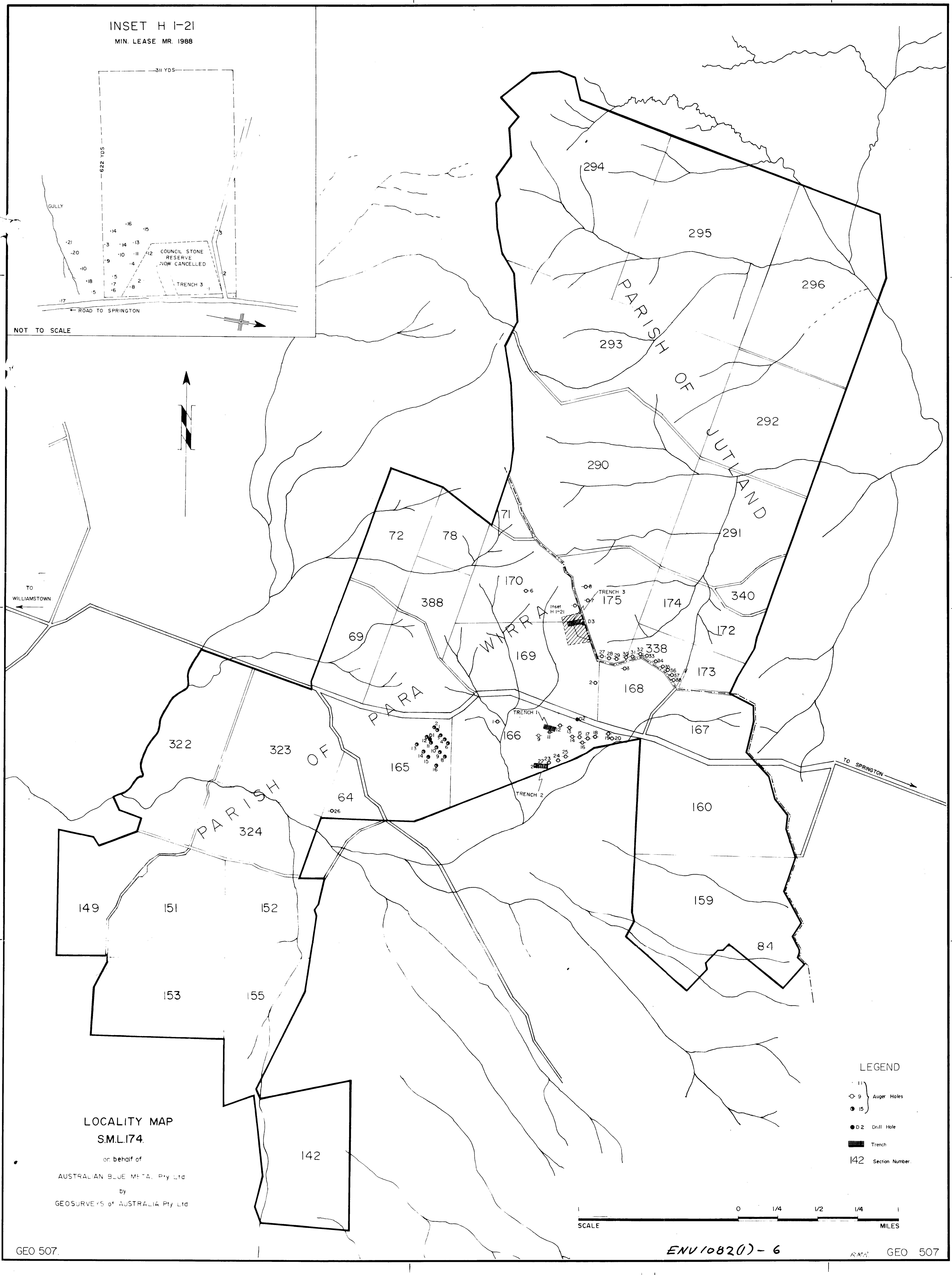
TENTATIVE CONCLUSIONS

Three trenches have been excavated in clayey deposits located previously by auger techniques. The two southern deposits carry considerable iron staining and although developed in metasomatised sediments do not give promise of underlying high grade deposits. Rutile is a significant additional contaminant.

The northernmost trench provided a clearer view of essentially silica sand deposits however carrying a proportion of recoverable kaolin. Rutile is again a contominant, but could possibly (as in the foregoing areas) repay recovery in the course of clay beneficiation.

A. T. von Sanden

for R. C. SPRIGG


INSET H 1-21
MIN. LEASE MR. 1988
311 YDS
622 YDS
GULLY
COUNCIL STONE RESERVE NOW CANCELLED
TRENCH 3
ROAD TO SPRINGTON
NOT TO SCALE
PARISH OF JUTLAND
PARISH OF PARA WIRRA
294
295
296
293
292
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291
340
175
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172
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167
170
388
72
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324
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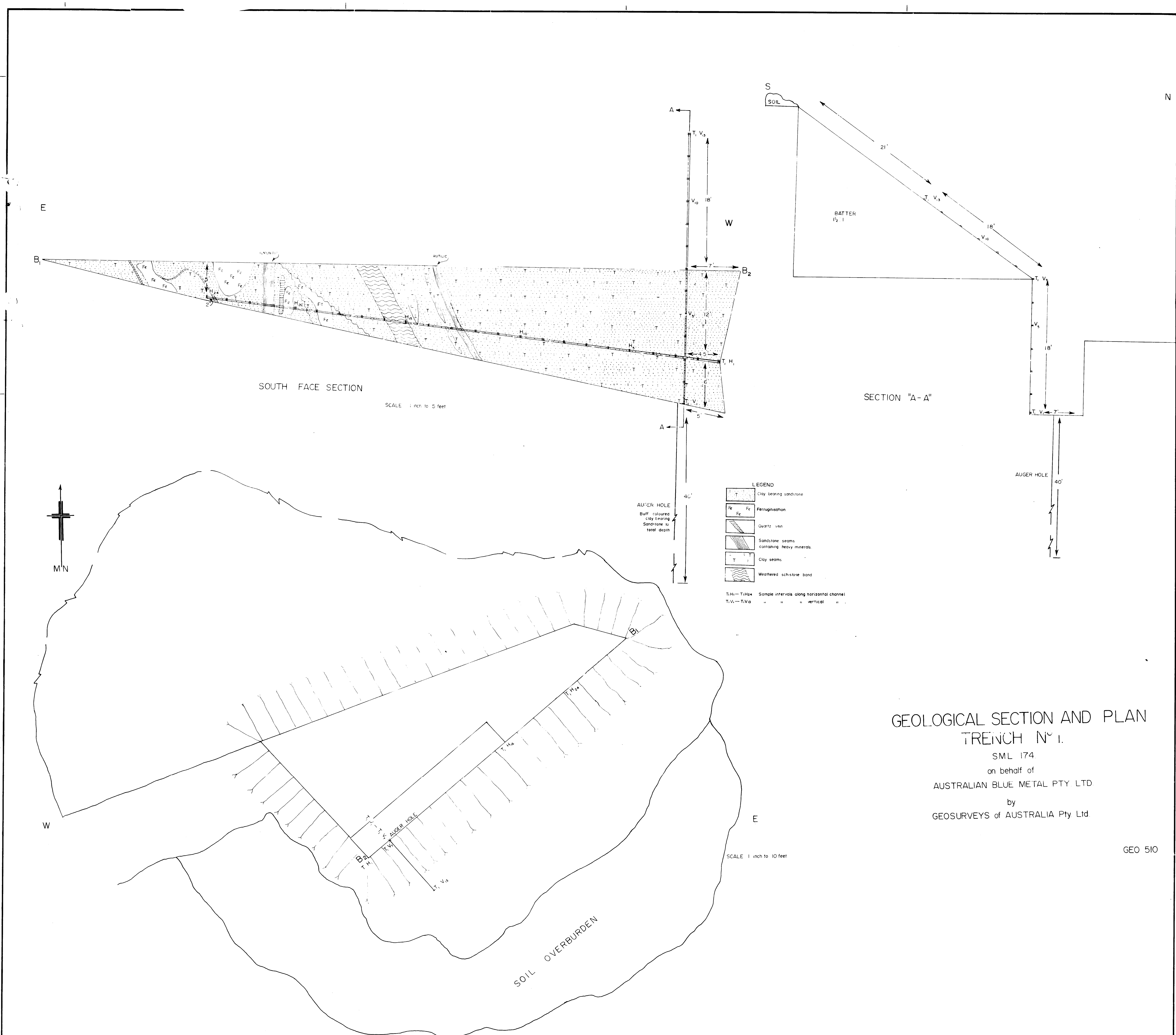
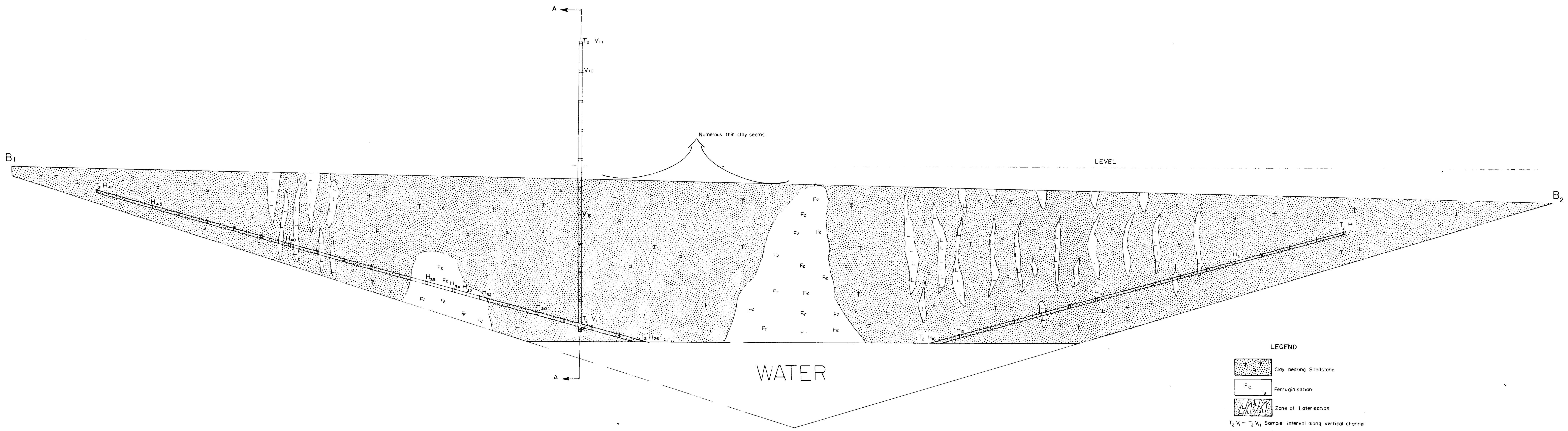
151
152
153
155
142
160
159
84
TRENCH 1
TRENCH 2
TRENCH 3
Inset H 1-21
D2
D3
TO WILLIAMSTOWN
TO SPRINGTON
LEGEND
Auger Holes
D2 Drill Hole
Trench
142 Section Number
SCALE
0
1/4
1/2
3/4
1
MILES
LOCALITY MAP
S.M.L.174.
on behalf of
AUSTRALIAN BLUE METAL Pty Ltd
by
GEOSURVEYS of AUSTRALIA Pty Ltd
GEO 507.
ENV 1082(1) - 6
GEO 507



ENV 1082(1) — 7

GEO 510



SOUTH FACE SECTION

Scale 1" to 5'

LEGEND

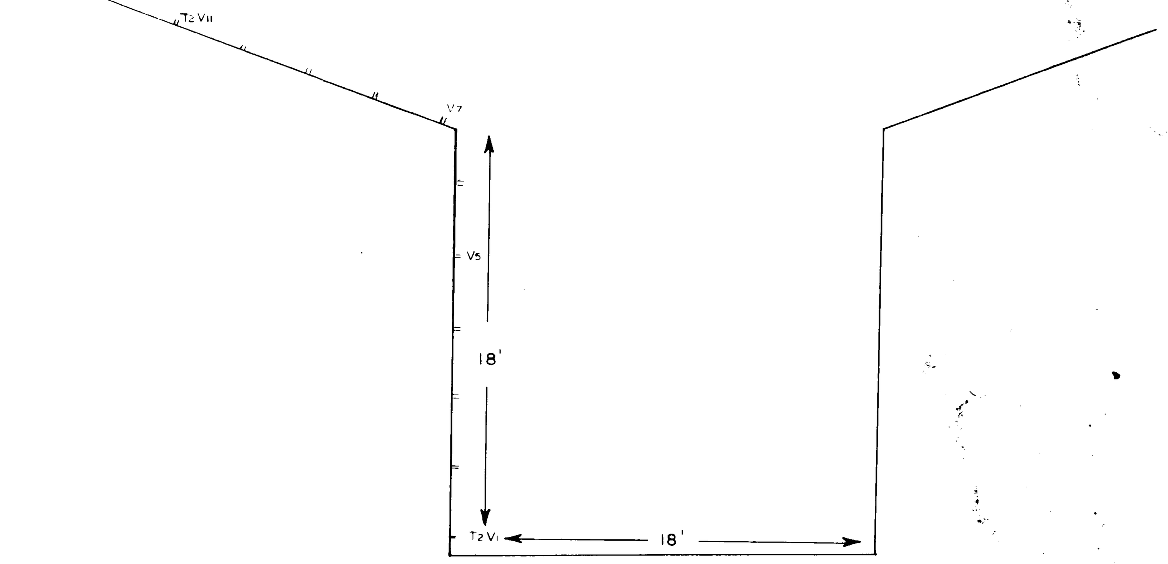
Clay bearing Sandstone

Ferruginisation

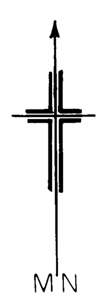
Zone of Laterisation

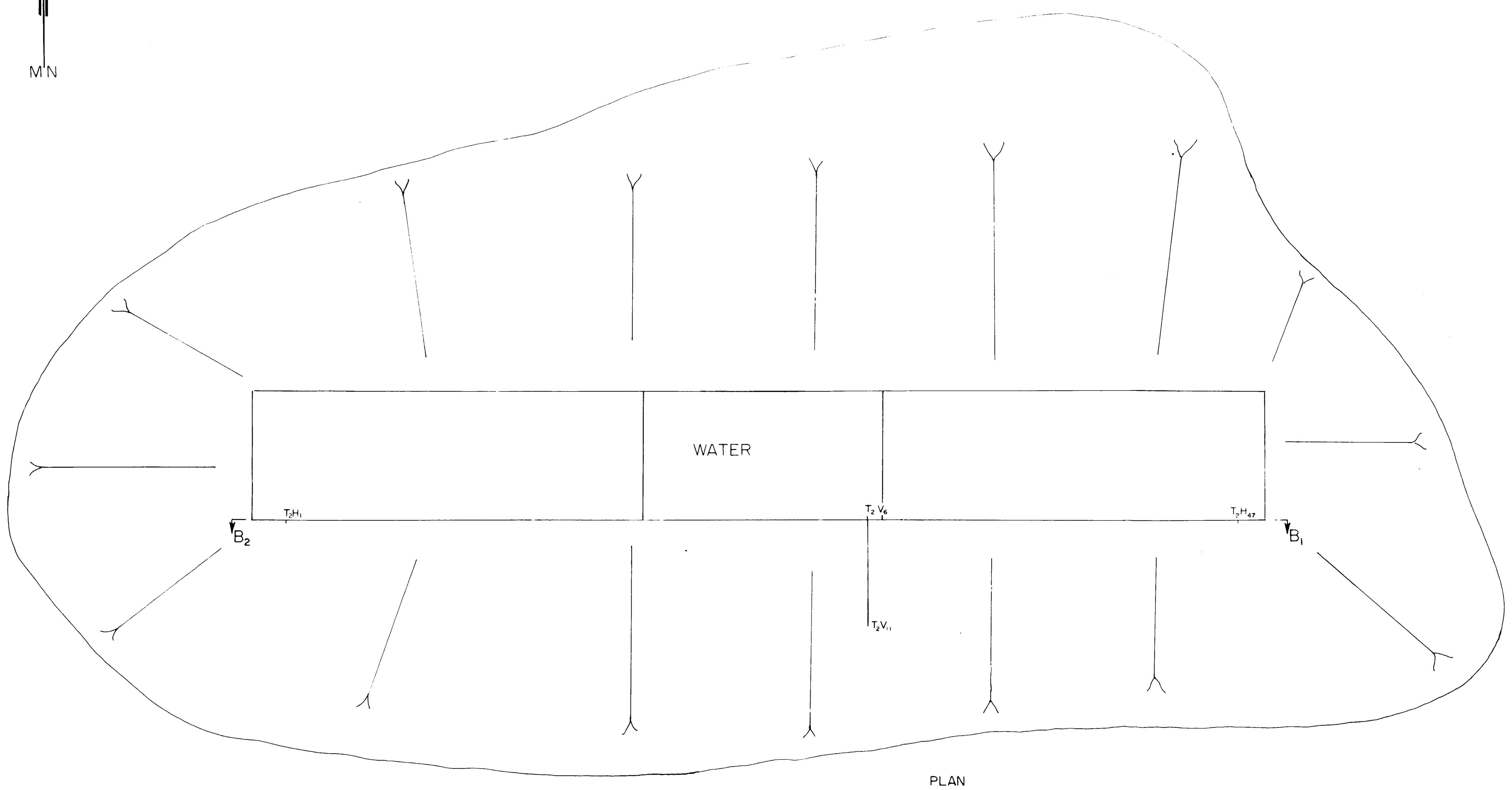
$T_2V_1 - T_2V_{11}$ Sample interval along vertical channel

$T_2H_1 - T_2H_{47}$ " " " horizontal "



SECTION "A – A"





PLAN

SCALE 1 inch to 10 feet

× AUGER HOLE

GEOLOGICAL SECTION AND PLAN
TRENCH No. 2.

SML 174

on behalf of

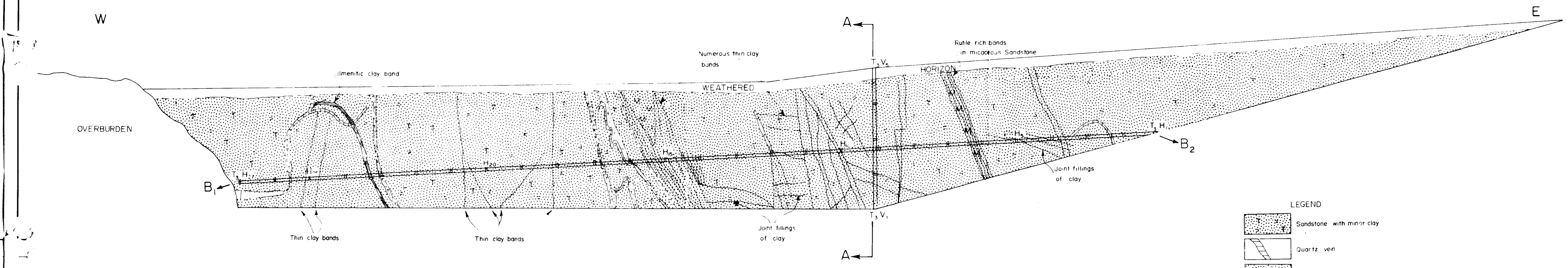
AUSTRALIAN BLUE METAL PTY LTD

by

GEOSURVEYS of AUSTRALIA Pty Ltd

ENV 1082(1) - 8

GEO 51



NORTH FACE SECTION

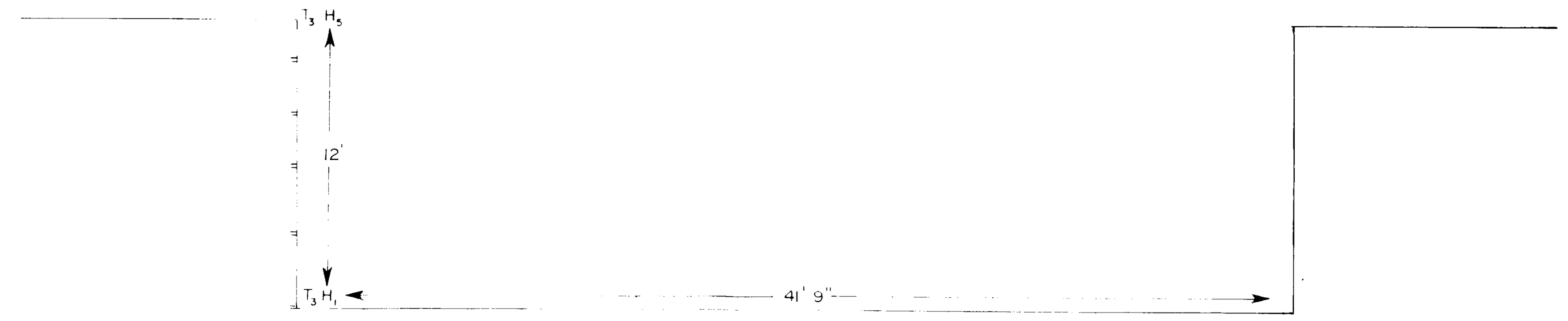
SCALE 1 inch to 5 feet

LEGEND

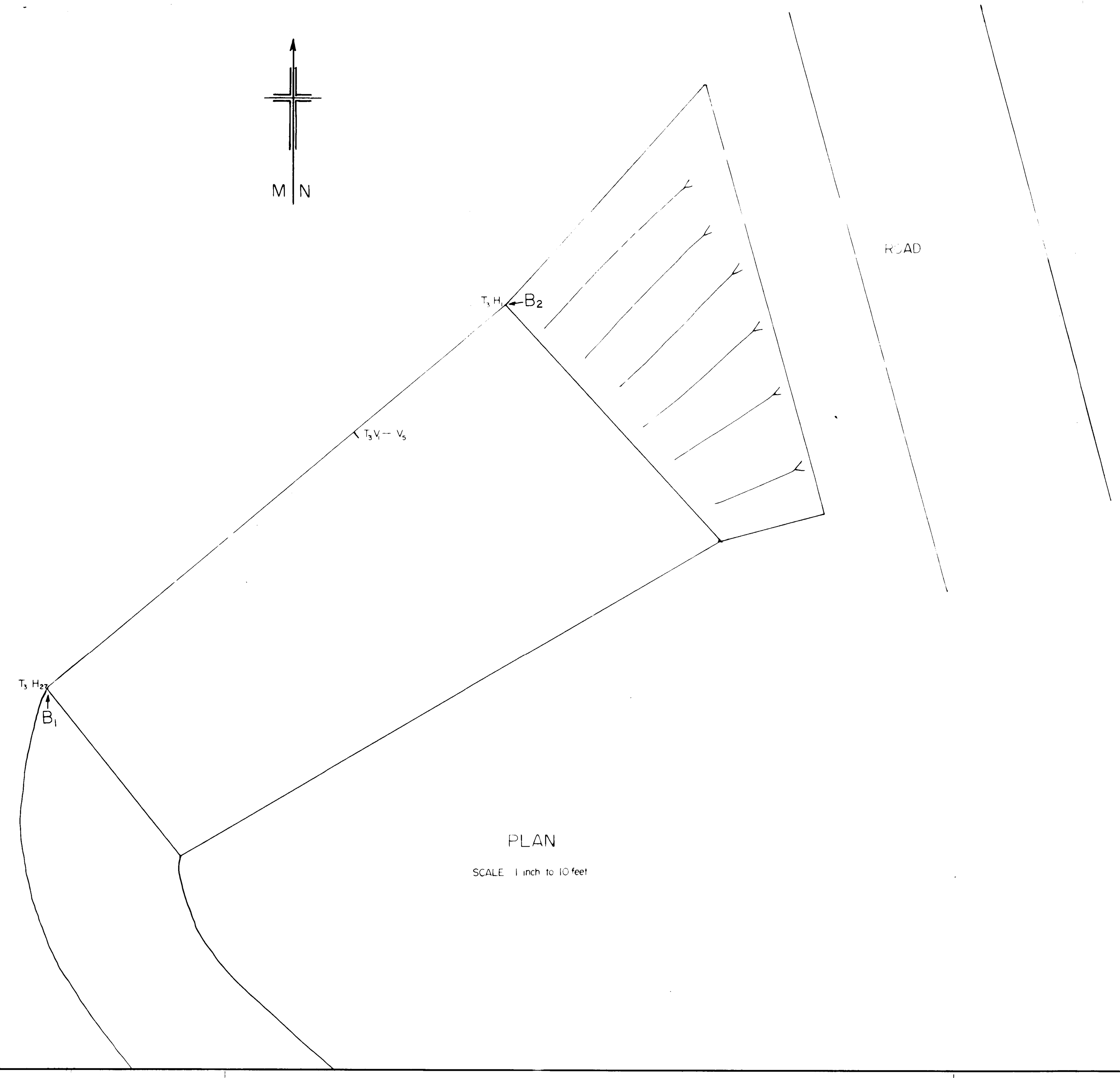
- Sandstone with minor clay
- Quartz vein
- Micaceous Sandstone
- Clay seam

T3H1 – T3H27 Sample intervals along horizontal channel.

T3V1 – T3V5 " " " vertical "



SECTION "A-A"



PLAN

SCALE 1 inch to 10 feet

GEOLOGICAL SECTION AND PLAN
TRENCH N° 3

SML 174

on behalf of

AUSTRALIAN BLUE METAL PTY. LTD

by

GEOSURVEYS of AUSTRALIA Pty Ltd

GEO 512

ENV 1082(1)-11

GEO 512

Section 166, Hd. Para Wirra, Co. Adelaide

- Australian Industrial Minerals N.L. -

050

by

M.G. MASON
GEOLOGIST
METALLIC MINERALS SECTION

CONTENTS

Rept. Bk. No. 64/115
G.S. 5728
DM. 1825/66

20th June, 1967

CLAY DEPOSIT, SPRINGTON

Section 166, Hd. Para Wirra, Co. Adelaide 051

- Australian Industrial Minerals N.L. -

ABSTRACT

Geological and topographical mapping of a white kaolin clay claim on section 166, Hd. Para Wirra, and laboratory ceramic investigation of representative borehole samples has been conducted.

White clay, formed by intense leaching of Kanmantoo rocks, is refractory and potentially useful in ceramics. However the deposit is not fully defined and further exploration by drilling and trenching is recommended.

Possible reserves amount to 13,000 c.yds. (20,000 tons) of clay under 11,000 c.yds. of overburden and occurs in a thin bed overlying coloured clay. There is some suggestion of thickening to the north.

INTRODUCTION

A geological and topographical survey was carried out on Section 166, Hd. Para Wirra, three miles west of Springton (See Fig. 1) for Australian Industrial Minerals N.L. This is leasehold land with mineral rights reserved to the Crown.

White kaolin clay was discovered on this section by Mr. I.W. Venning who holds Mineral Claim 4980 over the area. He has granted a twelve month option to the property to the above company. Limited auger drilling by the Company proved the presence of white clay at shallow depth. Laboratory testing (See Appendix 3) showed the clay to be refractory and potentially useful for ceramic purposes.

A stadia survey was carried out by R.K. Tarvydas in January, 1967, and a programme of auger drilling began on the 21st February, 1967. This was under the supervision of the author and was completed on 23rd February, 1967. Detailed drilling results are in Appendix 1. Eighteen holes averaging 30 feet were drilled for a total footage of 506 feet.

Three composite samples from the boreholes were submitted to the Australian Mineral Development Laboratories (AMDEL) for testing. Details of the sample composites and test results are shown in Appendix 2.

GEOLOGICAL SETTING

The deposit lies in a broad basin within undulating range country. Locally the claim extends over the northwest slope of a flat knoll which rises to 30 feet above plain level (See Fig. 2). The area is almost treeless, used for sheep grazing, and has a rainfall of 27 inches per annum.

Sediments equated with the Hindmarsh Clay of Pleistocene Age overlie clay and sands formed by deep weathering of rocks of the Kanmantoo Group. (See Fig. 4).

The Hindmarsh Clay sequence consists of 1 to 2 feet of fine sand overlying 2 to 8 feet of high plasticity red-brown and khaki mottled clay. A pebble bed 0.5 feet thick is often present at the base of the mottled clay.

The underlying weathered Kanmantoo sequence does not outcrop on Section 166 and the following description is based on auger drill samples.

The sequence consists of clays with 5 to 20% sand particles and sands with 10 to 50% clay content. The clay is of high, and in a few cases, moderate plasticity. In the upper part of the profile the clay is off white or pale grey in colour but passes downwards to yellow and red-brown clay. The colour is mainly due to iron compound impurities while the sand is well rounded silica grains in a matrix of pale coloured clay.

The geological setting is interpreted as a steeply dipping sequence of interbedded argillaceous and arenaceous rocks of the Kanmantoo Group whose upper portion has been altered by intense leaching to clays and clayey sands.

Thus useful clay can be expected to occur in bands of limited depth which pass laterally into sandy sediments and downwards into unaltered rock.

DRILLING

A total of 18 holes were drilled by the GEMCO auger on an irregular grid pattern (See Fig. 3). Results showed a band, consisting essentially of clay, trending in a northwest direction, trough bores 18, 1 and 2 and probably dipping near to vertical. This picture is not conclusive due to the lack of information, but agrees with the general regional structure of the Kanmantoo rocks.

The remaindr of the area drilled is underlain by yellow-brown and red-brown sands and clayey sands.

Reference to Fig. 3 shows that the white clay band lies partly outside of the claim boundaries. Repegging will be necessary to secure all of the clay deposit.

PHYSICAL PROPERTIES

Three composite samples were made up from the borehole samples and sent to AMDEL for laboratory testing (for details of sections used and results see Appendix 2).

Essentially they were

(i) The white kaolin clay at the top of the Kanmantoo sequence. CE2077/67

(ii) The yellow clay within the Kanmantoo sequence CE2078/67

(iii) Representative sample of all clays within the Kanmantoo sequence. (CE2347/67)

Preliminary ceramic investigations showed that the samples representing (ii) and (iii) above, would be suitable only for brick manufacture.

However testing of the white kaolin clay sample showed an Al_2O_3 content of 29.1 and a Pyrometric Cone Equivalent of 28, indicating that it may be suitable for refractories. The sample tested was not washed and included some sandy clay (e.g. Bores 3 and 4) so the results must be regarded as only indicative of the type of clay present. It is considered that if the sandy sections had been eliminated from the sample a higher quality clay would have resulted.

RESERVES

Reserves cannot be accurately assessed because the area has not been thoroughly drilled. Examination of the drill hole samples showed that white clay occurs in Bores 1, 2, 9, 10, 13, 15, 17 and 18 averaging 6 feet in thickness. Overburden in these bores averages 5 feet in thickness.

Within the area defined on Fig. 3 there may be 13,000 c.yds. of kaolin clay overlain by 11,000 c.yds. of overburden.

CONCLUSIONS

White kaolin clay occurs in a band trending northwest through bores 1 and 2. Further exploration is required to define the extent of this clay. The white clay passes downwards into yellow and brown clay.

Laboratory testing of composite bore samples has shown the white clay to be refractory and to be potentially useful in the ceramics industry. The underlying coloured clay is suitable only for brick manufacture.

Drilling has shown that the white clay occurs in a relatively thin (average depth 6 feet) horizontally dispersed band within the northwest trending band and that the clay is overlain by an almost equal (5 feet) thickness of overburden. Hole 2 in the centre of this zone showed 10 feet of white clay and deeper clay sections possibly exist to the north of Hole 2.

Within the area defined on Fig. 3 there are, on the basis of 5 feet of overburden and 6 feet of clay 20,000 tons of clay and 11,000 c.yds. of overburden. Portions of the bed are outside of the existing claim boundaries.

If investigation shows that a deposit of these dimensions can be economically worked, then further exploration should be carried out.

This should take the form of:

.... Auger drilling at 50 foot intervals in an east-west direction and 100 foot intervals in a north-south direction across the band shown in Fig. 3.

.... Bulldozing or trenching at selected spots to prove continuity of the clay between drill holes.

.... Further ceramic testing of representative samples from 1 and 2 above.

.... Adjustment of claim boundaries.

M.G. Mason

M.G. MASON
GEOLOGIST
METALLIC MINERALS SECTION

MGM:SMA
20.6.1967

DEPARTMENT OF MINES - SOUTH AUSTRALIA

LOG OF AUGER DRILL HOLE

064

HOLE NO. 1

SHEET 1 OF 1

PROJECT SPRINGTON KAOLIN-CLAY PROSPECT for AUST. IND. MIN. LTD.

LOCATION 3 MILES WEST SPRINGTON Sec. 166 Hd PARA WIRRA

FEATURE Depth 34 FT R.L. 999 Coords

Stratigraphy	SOIL TYPE GEOLOGICAL DESCRIPTION	CASING R.L. (FEET)	DEPTH (FEET)	GRAPHIC LOG	GROUP SYMBOL	SOIL DESCRIPTION GROUP NAME	CONSISTENCY REL. DENSITY	MOISTURE CONTENT	WATER LEVELS	REMARKS
PLEISTOCENE RECENT HINDMARSH CLAY	TOPSOIL				SM	SAND - medium grained 25% silt	VL	H		
	B Soil horizon.				CH	CLAY - Red brown, khaki mottled. High plasticity.	H	H		
CAMRIAN-KANMANTOO GROUP Tertiary Weathering	Kaolin Clay - Sand-well rounded silica grains.	990	5, 10		CH	CLAY - 3% fine grained sand 3% muscovite. Pale grey high plasticity.	H	H		KAOLIN CLAY SECTION
	Discoloured Kaolin Clay. Well rounded silica grains.	980, 970	15, 20, 25, 30		CH	CLAY - 5% - Fine grained sand - High plasticity Yellow brown.	St, S	M, S	23 FEB '67	
						END OF HOLE 34.0 FT.				

TYPE OF SAMPLE	HYDROLOGY	CONSISTENCY	REL. DENSITY	MOISTURE		
Open Tube	Water cut	VS - Very Soft	VL - Very Loose	H - Humid	Plant No 184	Logged Mason
Sealed Tube	Static level	S - Soft	L - Loose	D - Damp	Type Gemco	Date 6 March
Auger barrel ..	Supply	F - Firm	C - Compact	M - Moist	Driller Stummer	Drawn Mason
Slush pump ...	Analysis (p.p.m)	St - Stiff	D - Dense	W - Wet	Started 21 Feb 67	Traced JW
	■ ← Water level.	VSt - Very Stiff	VD - Very Dense	S - Saturated	Finished 21 Feb 67	Checked
					PLAN S5766	Vertical Scale

DEPARTMENT OF MINES - SOUTH AUSTRALIA

LOG OF AUGER DRILL HOLE 065 HOLE No. 2

PROJECT SPRINGTON KAOLIN CLAY DEPOSIT. Hirer AUST. IND. MIN. LTD SHEET 1 OF 1

LOCATION 3 MILES WEST. SPRINGTON Sec 166 Hd PARA WIRRA

FEATURE Depth 36 FT R.L. 995 Coords

	SOIL TYPE GEOLOGICAL DESCRIPTION	CASING R.L. (FEET)	DEPTH (FEET)	GRAPHIC LOG	GROUP SYMBOL	SOIL DESCRIPTION GROUP NAME	CONSISTENCY REL. DENSITY	MOISTURE CONTENT	WATER LEVELS	REMARKS
PLEISTOCENE RECENT HINDMARSH CLAY	B Soil Horizon.				CH	CLAY-5% medium grained Brown-brown yellow mottled High Plasticity.	H	H		
	Sand-well rounded silica grains.	990			SC	SAND-40% clay-low to moderate plasticity. Yellow brown	VSt	H		
CAMBRIAN-KANMANTOO GROUP TERTIARY WEATHERING	High grade Kaolin clay.		5, 10, 15		CH	CLAY-less 2% sand High plasticity. White.	H	H		Kaolin Clay Section.
	Discoloured Kaolin Clay.	980	20, 25		CH	CLAY-2% fine grained sand-High plasticity Brown.	St / S	M / S	23 FEB '67	
	Discoloured Kaolin clay. Small % of Damourite	970, 960	30, 35		CH	CLAY-2% sand-High Plasticity-Pale brown.	S	S		
						END OF HOLE 36·0 Ft				

TYPE OF SAMPLE	HYDROLOGY	CONSISTENCY	REL. DENSITY	MOISTURE		
Open Tube	Water cut	VS-Very Soft	VL-Very Loose	H-Humid	Plant No 184	Logged Mason
Sealed Tube	Static level	S-Soft	L-Loose	D-Damp	Type Gemco	Date 6 Mar. '6
Auger barrel	Supply	F-Firm	C-Compact	M-Moist	Driller Stummer	Drawn Mason
Slush pump	Analysis (p.p.m)	St-Stiff	D-Dense	W-Wet	Started 21 FEB '67	Traced TW
	← Water level.	VSt-Very Stiff	VD-Very Dense	S-Saturated	Finished 21 FEB '67	Checked
					PLAN 55767	Vertical Scale

LOG OF AUGER DRILL HOLE 066

NO.	3
SHEET 1 OF 1	

PROJECT SPRINGTON KAOLIN CLAY DEPOSIT — Hirer AUST. IND. MIN. LTD.

LOCATION 3 MILES WEST SPRINGTON — Sec. 166 Hd PARA WIRRA.

FEATURE — Depth 34 Ft R.L. 998 Coords

SOIL TYPE	GEOLOGICAL DESCRIPTION	CASING R.L. (FEET)	DEPTH (FEET)	GRAPHIC LOG	GROUP SYMBOL	SOIL DESCRIPTION GROUP NAME	CONSISTENCY Rel. DENSITY	MOISTURE CONTENT	WATER LEVELS	REMARKS
PLEISTOCENE HINDMARSH CLAY	TOPSOIL				SM	SAND - fine grained - 25% silt 5% clay. Dark brown.	VL	H		
	B Soil Horizon. Sand - silica grains well rounded.		5		CH	CLAY - 5% medium grained sand. High Plasticity Yellow brown - brown mottled.	H	H		
CAMBRIAN - KANMANTOO GROUP Tertiary Weathering	Kaolin clay				CH	CLAY - 10% fine grained sand Moderate to high plasticity. Pink and grey white.	F	D		KAOLIN CLAY SECTION.
	Sand - well rounded silica - 3% angular black hematite. Pale green due to preserve of 5% damourite.	1990	10, 15, 20		SC	SAND - Fine to medium grained - 15% clay. Pale grey to light green lower down.	L	D		
	Gravel fragments indurated sandstone.	1980	25		GP	GRAVEL - 30% medium grained sand. Small amount of clay. Pale yellow	L	D	HOLE COLLAPSED WATER LEVEL BELOW 26.0 Ft	
	Sand - well rounded silica grains.	1970	30		SC	SAND - 30% clay - low plasticity Pale yellow.	L	D		KAOLIN CLAY SECTION.
						END OF HOLE 34.0 Ft.				

TYPE OF SAMPLE	HYDROLOGY	CONSISTENCY	REL. DENSITY	MOISTURE		
Open Tube	Water cut	VS - Very Soft	VL - Very Loose	H - Humid	Plant No 184	Logged Mason
Sealed Tube	Static level	S - Soft	L - Loose	D - Damp	Type Gemco	Date 6 Mar '67
Auger barrel	Supply	F - Firm	C - Compact	M - Moist	Driller Stummer	Drawn Mason
Slush pump	Analysis (p.p.m)	St - Stiff	D - Dense	W - Wet	Started 21 Feb 67	Traced JW
Casing	← Water level. (Date)	VSt - Very Stiff	VD - Very Dense	S - Saturated	Finished 21 Feb 67	Checked
		H - Hard			PLAN No. 55768	Vertical Scale 1 inch = 5 Ft

LOG OF AUGER DRILL HOLE 067

NO. T | SHEET 1 OF 1

PROJECT SPRINGTON KAOLIN CLAY PROSPECT — Hirer AUST. IND. MIN. LTD.

LOCATION 3 MILES WEST SPRINGTON — Sec 166 Hd PARA WIRRA

FEATURE — Depth 36FT R.L. 1001 Coords

Geological age	SOIL TYPE / GEOLOGICAL DESCRIPTION	CASING	R.L. (FEET)	DEPTH (FEET)	GRAPHIC LOG	GROUP SYMBOL	SOIL DESCRIPTION / GROUP NAME	CONSISTENCY / REL DENSITY	MOISTURE CONTENT	WATER LEVELS	REMARKS
PLEISTOCENE - RECENT HINDMARSH CLAY	TOPSOIL - little organic matter.					SM	SAND - fine grained - Brown 25% silt.	VL	H		
	B soil horizon					CH	CLAY - 5% fine grained sand. High Plasticity. Khaki and yellow brown mottled.	H	H		
	GRAVEL Fragments mainly quartz some hematite.			5		GC	GRAVEL - 30% Clay, high plasticity - Khaki, red brown mottled. 10-30 m.m. diameter.	C	H		
CAMBRIAN KANMANTOO GROUP. TERTIARY WEATHERING	Kaolin Clay. Rounded Silica grains.		990	10, 15, 20		CL	CLAY - 35% medium grained sand. Low to moderate plasticity. White.	L	H	23 FEB 67	KAOLIN CLAY SECTION.
	Kaolin Clay. Rounded Silica grains.		980	25		CL / CH	CLAY - 25% medium grained sand. Moderate plasticity. Pale Pink.	S	W		
	Kaolin Clay rounded silica grains.		970	30, 35		CH	CLAY - 15% medium grained sand. High plasticity. Yellow.	VS	S		
							END OF BORE 36·0 Ft.				

TYPE OF SAMPLE	HYDROLOGY	CONSISTENCY	REL. DENSITY	MOISTURE		
Open Tube	Water cut	VS - Very Soft	VL - Very Loose	H - Humid	Plant No 184	Logged Mason
Sealed Tube	Static level	S - Soft	L - Loose	D - Damp	Type Gemco	Date 3 March 67
Auger barrel	Supply	F - Firm	C - Compact	M - Moist	Driller Stummer	Drawn Mason
Slush pump	Analysis (p.p.m)	St - Stiff	D - Dense	W - Wet	Started 21 FEB 67	Traced SW
Casing	Water level (Date)	VSt - Very Stiff	VD - Very Dense	S - Saturated	Finished 21 FEB 67	Checked
		H - Hard			PLAN No 65769	Vertical Scale

LOG OF AUGER DRILL HOLE 068

HOLE NO. 5 — SHEET 1 OF 1

PROJECT SPRINGTON KAOLIN CLAY DEPOSIT — Hirer AUST. IND. MIN. LTD.

LOCATION 3 MILES WEST SPRINGTON — Sec. 166 Hd PARA WIRRA

FEATURE — Depth 36 FT R.L. 997 Coords

Stratigraphy	Soil Type / Geological Description	Casing	R.L. (Feet)	Depth (Feet)	Group Symbol	Soil Description / Group Name	Consistency / Rel. Density	Moisture Content	Water Levels	Remarks
PLEISTOCENE - RECENT HINDMARSH CLAY	TOPSOIL - little organic matter				SM	SAND - Fine grained - brown - 20% silt and clay.	VL	H		
	B Soil Horizon.			5	CH	CLAY - 5% fine grained sand. High plasticity - Yellow brown.	V.St.	D		
CAMBRIAN - KANMANTOO GROUP Tertiary Weathering	Probably red and white alternating bands less 10 mm. thick. Well rounded silica grains. Kaolin Clay.		1990	10	SC	SAND - medium grained 40% Clay - Red brown and white. Low plasticity.	C	D		KAOLIN CLAY SECTION.
	Well rounded Silica grains. Kaolin Clay.		1980	15	SC	SAND - medium grained. 40% clay - white. Low Plasticity.	C	D		
	Kaolin Clay - Silica grains.				CH	CLAY - 20% Medium grained Sand. White. Moderate to High Plasticity.	F	M		
	Well rounded silica grains.		1970	20, 25, 30, 35	CL	CLAY - 30-40% Fine to medium grained sand. Low to moderate plasticity. Yellow Brown.	F / S	M / S	23 FEB 67	

END OF HOLE 36.0 Ft.

TYPE OF SAMPLE	HYDROLOGY	CONSISTENCY	REL. DENSITY	MOISTURE		
Open Tube	Water cut	VS - Very Soft	VL - Very Loose	H - Humid	Plant No 184	Logged Mason
Sealed Tube	Static level	S - Soft	L - Loose	D - Damp	Type Gemco	Date 3 Mar '67
Auger barrel	Supply	F - Firm	C - Compact	M - Moist	Driller Stummer	Drawn Mason
Slush pump	Analysis (ppm)	St - Stiff	D - Dense	W - Wet	Started 22 Feb 67	Traced J.W.
Casing	← Water level. (Date)	VSt - Very Stiff	VD - Very Dense	S - Saturated	Finished 22 Feb 67	Checked
		H - Hard			PLAN 55770	Vertical Scale

LOG OF AUGER DRILL HOLE 069

NO. | SHEET 1 OF 1

PROJECT SPRINGTON KAOLIN CLAY PROSPECT — Hirer AUST. IND. MIN. LTD.

LOCATION 3 MILES WEST SPRINGTON — Sec. 166 Hd PARA WIRRA

FEATURE — Depth 30 FT R.L. 1000 Coords

	SOIL TYPE GEOLOGICAL DESCRIPTION	CASING	R.L. (FEET)	DEPTH (FEET)	GROUP SYMBOL	SOIL DESCRIPTION GROUP NAME	CONSISTENCY REL. DENSITY	MOISTURE CONTENT	WATER LEVELS	REMARKS
PLEISTOCENE – RECENT HINDMARSH CLAY	TOPSOIL - small amount of organic matter.				SM	SAND - 15% silt and clay - fine grained - Brown.	VL	H		
	B Soil Horizon.				CH	CLAY - 3% sand - yellow brown. High Plasticity.	ST.	D		
				5	CL	CLAY - 20% sand - moderate plasticity - Red brown, yellow brown mottled.	F	M		
					CL	CLAY - 45% medium grained sand. Grey-white. Low Plasticity.	F	M		
	Subrounded quartz Pebbles;		990		GC	GRAVEL - 5-20mm diameter 20 brown clay. Moderate Plasticity	C	M		
CAMBRIAN - KANMANTOO GROUP. TERTIARY WEATHERING.	Kaolin Clay - Rounded silica grains.			10, 15	CL	CLAY - 40% sand medium grained Grey white - Low Plasticity.	L	M		KAOLIN CLAY SECTION.
	Kaolin Clay - rounded hematite coated silica grains.		980		CL	CLAY - 30% medium grained sand - Pale pink. Low to moderate plasticity.	L	M		
	Kaolin clay rounded silica grains.		970	20, 25, 30	CH	CLAY - 15% medium grained sand. White. Moderate to high plasticity. Occasional Quartz pebble 10-20mm diameter.	VS	S	HOLE COLLAPSED WATER LEVEL BELOW 24.0 Ft.	
						END OF HOLE 30.0 Ft.				

TYPE OF SAMPLE	HYDROLOGY	CONSISTENCY	REL. DENSITY	MOISTURE		
Open Tube	Water cut	VS - Very Soft	VL - Very Loose	H - Humid	Plant No 184	Logged Mason
Sealed Tube	Static level	S - Soft	L - Loose	D - Damp	Type Gemco	Date 3 Mar 67
Auger barrel	Supply	F - Firm	C - Compact	M - Moist	Driller Stummer	Drawn Mason
Slush pump	Analysis (p.p.m.)	St - Stiff	D - Dense	W - Wet	Started 22 Feb 67	Traced JW
Casing	← Water level. (Date)	VSt - Very Stiff	VD - Very Dense	S - Saturated	Finished 22 Feb 67	Checked
					PLAN S5771	Vertical Scale 1 inch = 5 Ft.

LOG OF AUGER DRILL HOLE 070

NO. 0 | SHEET 1 OF 1

PROJECT SPRINGTON KAOLIN CLAY DEPOSIT. Hirer AUST. IND. MIN. LTD

LOCATION 3 MILES WEST SPRINGTON Sec 166 Hd PARA WIRRA.

FEATURE Depth 13·0 ft R.L. 998 Coords

Geological Description	Soil Type	Casing R.L. (Feet)	Depth (Feet)	Graphic Log	Group Symbol	Soil Description Group Name	Consistency Rel. Density	Moisture Content	Water Levels	Remarks
Pleistocene–Recent Hindmarsh Clay Equivalent	TOPSOIL - little organic matter				SM	SAND - fine grained - Brown 25% silt.	VL	H		
	B Soil Horizon.		5		CH	CLAY - 5% fine grained sand. Yellow brown to red brown. - High Plasticity.	V.St.	D		
Cambrian–Kanmantoo Group. Tertiary weathering.	Kaolin Clay.		1990		CH	CLAY - 5% fine grained sand White. High Plasticity.	St	D		KAOLIN CLAY SECTION.
	Kaolin Clay sand.		10		SC / CH	SAND-CLAY - 50% fine grained sand. 5% course indurated Kaolin? Rest moderate plasticity clay White.	L	H.		
	less weathered bedrock.					Weathered silty sandstone.				
						END OF HOLE 13·0 Ft.				

TYPE OF SAMPLE	HYDROLOGY	CONSISTENCY	REL. DENSITY	MOISTURE		
Open Tube	Water cut	VS-Very Soft	VL-Very Loose	H-Humid	Plant No 184	Logged Mason
Sealed Tube	Static level	S-Soft	L-Loose	D-Damp	Type Gemco.	Date 2 Mar 67
Auger barrel	Supply	F-Firm	C-Compact	M-Moist	Driller Stummer	Drawn Mason
Slush pump	Analysis (p.p.m)	St-Stiff	D-Dense	W-Wet	Started 22 Feb 67	Traced JW
Casing	← Water level. (Date)	VSt-Very Stiff	VD-Very Dense	S-Saturated	Finished 22 Feb 67	Checked
		H-Hard			PLAN NO. S5772	Vertical Scale 1 inch = 5 Ft.

LOG OF AUGER DRILL HOLE 071

NO. | SHEET 1 OF 1

PROJECT SPRINGTON KAOLIN CLAY DEPOSIT — Hirer AUST. IND. MIN. LTD.

LOCATION 3 MILES WEST SPRINGTON — Sec. 166 Hd PARA WIRRA

FEATURE — Depth 15·0 Ft R.L. 999 Coords

SOIL TYPE GEOLOGICAL DESCRIPTION		CASING	R.L. (FEET)	DEPTH (FEET)	GRAPHIC LOG	GROUP SYMBOL	SOIL DESCRIPTION GROUP NAME	CONSISTENCY REL. DENSITY	MOISTURE CONTENT	WATER LEVELS	REMARKS
PLEISTOCENE RECENT HINDMARSH CLAY B.				0–5		CH	CLAY - 10% fine sand - Brown to Red brown. High plasticity. Granular texture.	St.	D		
CAMBRIAN-KANMANTO GROUP Tertiary Weathering.	Silica and hematite sand particles. Well rounded grains.		990	5–10		SC	SAND - 30% clay - pale pink. low to moderate plasticity.	L	D		
	Sand is silica. Kaolin Clay.			10–15		CH	CLAY - 10% Fine grained sand. White moderate to high plasticity.	F.	M		KAOLIN CLAY SECTION.
				15			Quartz fragments - Bed-rock.				
							END OF HOLE 15·0 Ft.				

TYPE OF SAMPLE	HYDROLOGY	CONSISTENCY	REL. DENSITY	MOISTURE		
Open Tube	Water cut	VS-Very Soft	VL-Very Loose	H-Humid	Plant No 184	Logged MASON
Sealed Tube	Static level	S-Soft	L-Loose	D-Damp	Type Gemco	Date 2 mar 67
Auger barrel	Supply	F-Firm	C-Compact	M-Moist	Driller Stummer	Drawn Mason
Slush pump	Analysis (ppm)	St-Stiff	D-Dense	W-Wet	Started 22 FEB 67	Traced JW
Casing	← Water level. (Date)	VSt-Very Stiff	VD-Very Dense	S-Saturated	Finished 22 FEB 67	Checked
		H-Hard			PLAN NO. S5773	Vertical Scale 1 inch = 5 ft.

LOG OF AUGER DRILL HOLE 072

NO. 9

SHEET 1 OF 1

PROJECT SPRINGTON KAOLIN CLAY PROSPECT. Hirer AUST.IND.MIN.LTD.

LOCATION 3 MILES WEST SPRINGTON. Sec.166 Hd PARA WIRRA

FEATURE

Depth 30.0Ft R.L. 996 Coords

Stratigraphy	SOIL TYPE GEOLOGICAL DESCRIPTION	CASING R.L.(FEET)	DEPTH (FEET)	GRAPHIC LOG	GROUP SYMBOL	SOIL DESCRIPTION GROUP NAME	CONSISTENCY REL. DENSITY	MOISTURE CONTENT	WATER LEVELS	REMARKS
PLEISTOCENE - RECENT HINDMARSH CLAY ?	TOPSOIL - little organic matter.				SM	SAND Fine grained - Dark brown. 25% silt.	VL	H		
	B Soil Horizon.	990	5		CH	CLAY - High plasticity - 2% sand. Light brown.	VS	D		
					GP	GRAVEL - Average 10m.m diam	L	H		
CAMBRIAN - KANMANTOO GROUP Tertiary Weathering	Kaolin.				CH	CLAY - High plasticity - 5% sand. White to pale grey.	St.	D		KAOLIN CLAY SECTION.
	Sand grains, silica well rounded.		10		SC	SAND - 40% Kaolin clay. medium grained sand. - White.	L	D		
					SC	SAND - 30% Kaolin clay and damourite. Medium to course sand. Pale green.	L	D		
					SM	SAND - 15% silt. Pale Brown. Fine grained sand.	L	D		
	Sand particles pink in colour either hematite coated quartz	1980	15		SM	SAND - 10% Kaolin clay - White - fine grained sand.	L	D		
			20		SC	SAND - 45% clay and silt. Pink - fine grained sand. Low to moderate plasticity	L	D		
		1970	25							
			30		SC	SAND - 40% clay and silt. Pale yellow - fine grained sand - Moderate plasticity.	L	D		
						END OF HOLE 30.0 Ft.				

TYPE OF SAMPLE	HYDROLOGY	CONSISTENCY	REL. DENSITY	MOISTURE		
Open Tube	Water cut	VS-Very Soft	VL-Very Loose	H-Humid	Plant No 184	Logged M.G.MASON
Sealed Tube	Static level	S-Soft	L-Loose	D-Damp	Type GEMCO.	Date 2 Mar 67
Auger barrel	Supply	F-Firm	C-Compact	M-Moist	Driller STUMMER	Drawn M.G.MASON
Slush pump	Analysis (p.p.m)	St-Stiff	D-Dense	W-Wet	Started 22 FEB 67	Traced JW
Casing	← Water level.	VSt-Very Stiff	VD-Very Dense	S-Saturated	Finished 22 FEB 67	Checked
					PLAN 55774	Vertical Scale

... SOUTH AUSTRALIA

LOG OF AUGER DRILL HOLE 073

HOLE NO. 10 — SHEET 1 OF 1

PROJECT SPRINGTON KAOLIN CLAY PROSPECT. Hirer AUST. IND. MIN. LTD

LOCATION 3 MILES WEST SPRINGTON. Sec 166 Hd PARA WIRRA.

FEATURE

Depth 24 FT R.L. 984 Coords

	SOIL TYPE. GEOLOGICAL DESCRIPTION	CASING	R.L. (FEET)	DEPTH (FEET)	GRAPHIC LOG	GROUP SYMBOL	SOIL DESCRIPTION GROUP NAME	CONSISTENCY REL. DENSITY	MOISTURE CONTENT	WATER LEVELS	REMARKS
PLEISTOCENE-RECENT HINDMARSH CLAY III	TOPSOIL.					SM	SAND - 20% silt. Some clay. Fine grained: Dark grey.	VL	H		
	B Soil Horizon.		980			CH	CLAY - 10% fine grained sand. High plasticity. Khaki; pale brown mottled.	H	H		
CAMBRIAN-KANMANTOO GROUP TERTIARY WEATHERING.	Kaolin Clay.			5		CH	CLAY - 10% fine grained sand. High plasticity. Pale grey.	V.St.	D		KAOLIN CLAY SECTION.
				10		CH	CLAY - 15% fine grained sand. High plasticity. Brown and green mottled.	St	M		
			970	15		CH	CLAY - 15% fine grained sand. Moderate to high plasticity. Very Pale yellow.	St	M		
						CH	CLAY - 25% fine grained sand. Moderate plasticity. Yellow brown.	St	M		
				20		CH	CLAY - 20% fine grained sand. Moderate plasticity. Pale yellow.	F	W	23 FEB '67	
	Sand 90% actinolite Dark green.		960			SC	SAND - 30% clay - low plasticity. Medium grained. Yellow green.	S	S.		

END OF HOLE 24.0 Ft

TYPE OF SAMPLE	HYDROLOGY	CONSISTENCY	REL. DENSITY	MOISTURE		
Open Tube	Water cut	VS - Very Soft	VL - Very Loose	H - Humid	Plant No 184	Logged MASON
Sealed Tube	Static level	S - Soft	L - Loose	D - Damp	Type GEMCO	Date 8 Mar '67
Auger barrel	Supply	F - Firm	C - Compact	M - Moist	Driller Stummer	Drawn MASON
Sludge sump	Analysis (p.p.m)	St - Stiff	D - Dense	W - Wet	Started 23 FEB 67	Traced JW
	Water level	VSt - Very Stiff	VD - Very Dense	S - Saturated	Finished 23 FEB 67	Checked

PLAN S 5775 Vertical Scale

LOG OF AUGER DRILL HOLE 074.

NO. 1 F

SHEET 1 OF 1

PROJECT SPRINGTON KAOLIN CLAY PROSPECT. Hirer AUST. IND. MIN. LTD.

LOCATION 3 MILES WEST SPRINGTON Sec. 166 Hd PARA WIRRA

FEATURE

Depth 30 FT R.L. 991 Coords

	SOIL TYPE* GEOLOGICAL DESCRIPTION	CASING R.L. (FEET)	DEPTH (FEET)	GRAPHIC LOG	GROUP SYMBOL	SOIL DESCRIPTION GROUP NAME	CONSISTENCY REL. DENSITY	MOISTURE CONTENT	WATER LEVELS	REMARKS
PLEISTOCENE-RECENT HINDMARSH CLAYS	TOPSOIL - organic matter.				SC	SAND - finegrained - 15% clay Black.	L	H		
	B Soil Horizon.				CH	CLAY - 5% fine grained sand High plasticity. Khaki - red brown mottled.	V.St	H		
CAMBRIAN-KANMANTOO GROUP Tertiary Weathering.	Kaolin Clay.		5		CH	CLAY - 20% fine to medium grained sand. Moderate to high plasticity. Pale Pink.	St	M		KAOLIN CLAY SECTION ↓
					CH	CLAY - 15% finegrained sand High plasticity - Red.	F	M		
		1980	10		CH	CLAY - 15% finegrained sand High plasticity. Pale yellow.	F	M		
	Gravel - probably sandstone band fragments (white) Sand mainly Well rounded silica. Some mica		15		CL	CLAY - 30% finegrained sand. 15% course gravel average 15 m.m. diameter. Moderate plasticity. Pale yellow	F	M	6 APRIL '67	
		1970	20		SC	SAND - 30% clay - sand fine grained. Low plasticity. Yellow.	F	W		
			25		SC	SAND - 30% clay - fine grained. Moderate plasticity Pale yellow.	F	W		
			30			END OF HOLE 30 Ft.				

TYPE OF SAMPLE	HYDROLOGY	CONSISTENCY	REL. DENSITY	MOISTURE
Open Tube	Water cut	VS-Very Soft	VL-Very Loose	H-Humid
Sealed Tube	Static level	S-Soft	L-Loose	D-Damp
Auger barrel	Supply	F-Firm	C-Compact	M-Moist
Sludge pump	Analysis (p.p.m)	St-Stiff	D-Dense	W-Wet
	Water level (Date)	VSt-Very Stiff	VD-Very Dense	S-Saturated
		H-Hard		

Plant No 184

Type GEMCO

Driller Stummer

Started 23 Feb 67

Finished 23 Feb 67

Logged MASON

Date 8 MAR '67

Drawn MASON

Traced JW

Checked

PLAN NO S5776

Vertical Scale 1 inch = 5 Ft

AUGER

SPRINGTON KAOLIN CLAY PROSPECT
3 MILES WEST SPRINGTON.

075

AUST. IND. MIN. LTD.

SHEET 1 OF 1

166 PARA WIRRA

30FT 993

								REMARKS
PLEISTOCENE-RECENT HINDMARSH CLAY	B Soil Horizon.	1990	5	CH	CLAY-5% finegrained sand. High plasticity. Khaki red brown mottled. occasional pebble.	H	H	
CAMBRIAN-KANMANTOO GROUP. Tertiary Weathering.	Kaolin Clay			CH	CLAY-10% fine sand. High plasticity. Red brown. Pale grey mottled.	H	H	KAOLIN CLAY SECTION.
	Sand-mainly well-rounded silica		10	CL	CLAY-30% finegrained sand. Moderate plasticity. Pale grey.	H	H	
		1980	15	CH	CLAY-20% finegrained sand-2% mica. High plasticity. Red brown.	F	M	
		1970	20	CH	CLAY-35% finegrained sand. Moderate to high plasticity-Yellow brown.	F	M	
			25, 30	CH	CLAY-30% fine to medium grained sand. High plasticity. Yellow.	VS	S	

END OF HOLE 30·0 Ft.

SAMPLE	HYDROLOGY	CONSISTENCY	REL. DENSITY	MOISTURE		
	Water cut	VS-Very Soft	VL-Very Loose	H-Humid	Plant No 184	Logged MASON
	Static level	S-Soft	L-Loose	D-Damp	Type GEMCO	Date 8 MAR 67
Auger barrel	Sample	F-Firm		M-Moist	Driller Stummer	Drawn MASON
	Analysis (ppm)				Started 23 Feb 67	Traced JW
	Water level				Finished 23 Feb 67	

S5777

LOG OF AUGER DRILL HOLE 076

NO. 10

SHEET 1 OF 1

PROJECT SPRINGTON KAOLIN CLAY PROSPECT. Hirer AUST. IND. MIN. LTD.

LOCATION 3 MILES. WEST SPRINGTON. Sec 166 Hd PARA WIRRA.

FEATURE

Depth 30 FT R.L. 999 Coords

SOIL TYPE GEOLOGICAL DESCRIPTION		CASING R.L. (FEET)	DEPTH (FEET)	GROUP SYMBOL	SOIL DESCRIPTION GROUP NAME	CONSISTENCY REL. DENSITY	MOISTURE CONTENT	WATER LEVELS	REMARKS
	TOPSOIL.			SM	SAND - 20% silt and clay. Dark brown.	L	H		
PLEISTOCENE - RECENT HINDMARSH CLAY	B Soil Horizon.		5	CH	CLAY - 10% gravel fragments average 10m.m. diameter 15% fine grained sand. High Plasticity. Brown.	V.St.	D		
CAMBRIAN KANMANTOO GROUP. Tertiary Weathering.	Kaolin Clay.	990	10	CH	CLAY - 5% fine grained sand. - High plasticity. White.	V.St.	D		KAOLIN CLAY SECTION. ↓
	Sand - Silica grains - constant size.	980	15, 20	SC	SAND - 40% clay - Low to moderate plasticity fine grained. Pale grey.	D	M	6 APRIL 67.	
			25	CH	CLAY - 20% fine grained sand. High plasticity. light grey.	VS	S		
		970	30	CH	CLAY - 20% fine grained sand. - Moderate to high plasticity. Brown.	VS	S		
					END OF HOLE 30.0 Ft				

TYPE OF SAMPLE	HYDROLOGY	CONSISTENCY	REL. DENSITY	MOISTURE		
Open Tube	Water cut	VS-Very Soft	VL-Very Loose	H-Humid	Plant No 184	Logged MASON
Sealed Tube	Static level	S-Soft	L-Loose	D-Damp	Type Gemco	Date 8 Mar 67
Auger barrel	Supply	F-Firm	C-Compact	M-Moist	Driller Stummer	Drawn MASON
Sludge pump	Analysis (p.p.m)	St-Stiff	D-Dense	W-Wet	Started 23 FEB 67	Traced JW
	Water level (Date)	VSt-Very Stiff	VD-Very Dense	S-Saturated	Finished 23 FEB 67	Checked
					PLAN S5778	Vertical Scale

AUGER [illegible] 077 No. 14

SPRINGTON KAOLIN CLAY PROSPECT. AUST. IND. MIN. LTD. SHEET 1 OF 1

3 MILES WEST SPRINGTON. 166 PARA WIRRA

Depth 24 FT R.L. 987 Coords

Age	Geological Description	R.L. (Feet)	Depth (Feet)	Graphic Log	Class	Description	Moisture	Rel. Density	Remarks
PLEISTOCENE-RECENT HINDMARSH CLAYS	TOPSOIL.				SM.	SAND-20% silt-some clay. Dark brown.	L	H	
CAMBRIAN-KANMANTOO GROUP. Tertiary Weathering	Kaolin Clay. Sand, silica grains well rounded.				CL	CLAY-40-50% sand fine to medium grained, moderate plasticity. Pink, pale yellow mottled.	C / St	H / D	KAOLIN CLAY SECTION. ↓
		980	5		CL	CLAY-45% sand fine to medium grained. Moderate plasticity. Very pale yellow.	St	M	
			10		CH	CLAY-30% sand fine grained. High plasticity. Pale brown.	S	W	
			15		CH	CLAY-20% sand fine grained-moderate to high plasticity Very pale brown.	S	W	
	Sand-constant size-silica grains well rounded.	970	20		SL	SAND-fine grained. 30% clay-Low plasticity Very pale yellow.	C	W	
						END OF HOLE 24·0 Ft.			

TYPE OF SAMPLE	HYDROLOGY	CONSISTENCY	REL. DENSITY	MOISTURE		
Open Tube	Water cut	VS-Very Soft	VL-Very Loose	H-Humid	Plant No 184	Logged MASON
Sealed Tube	Static level	S-Soft	L-Loose	D-Damp	Type GEMCO	Date 8 Mar 67
Auger Barrel	Supply	F-Firm	C-Compact	M-Moist	Driller Stummer	Drawn MASON
	Analysis (ppm)	St-Stiff	D-Dense	W-Wet	Started 23 FEB 67	Traced JW
	Water level	VSt-Very Stiff	VD-Very Dense	S-Saturated	Finished 23 FEB 67	Checked

65779 Vertical Scale

AUGER 078

SPRINGTON KAOLIN CLAY PROSPECT. AUST IND MIN LTD

3 MILES WEST SPRINGTON. 166. PARA WIRRA.

30 FT 985

Geological	Soil type description	R.L. (feet)	Depth (feet)	Graphic log	Unified	Soil description	Consistency	Moisture	Water levels	REMARKS
PLEISTOCENE-RECENT HINDMARSH CLAYS	TOPSOIL.				SM	SAND - 25% silt - Dark brown Fine grained.	VL	H		
	B Soil Horizon.				CH.	CLAY - 3% sand - High plasticity - Khaki, red brown mottled.	VST	D		
CAMBRIAN - KANMANTOO GROUP Tertiary Weathering	Kaolin Clay.	1980	5		CH.	CLAY - 2% sand. 1% muscovite. Pale grey and red brown mottled. High plasticity.	ST	M		KAOLIN CLAY SECTION. ↓
					CH.	CLAY - 3% sand medium grained - Pale grey. High plasticity.	F	W		
			10		CH	CLAY - 15% fine to medium grained sand - Pale brown. Moderate plasticity. Few small limonite nodules.	F	W		
	Sandgrains - silica well rounded. Clay Kaolin.	1970	15		SC	SAND - 30% clay - fine grained - 1% sandstone granules. 5m.m diameter Low plasticity - White.	VL	M		
	Well rounded silica grains.				CH	CLAY - 30% finegrained sand. Pale brown - moderate to high plasticity.	S	S	6 Apr 67.	
	1% muscovite	1960	20, 25		CH	CLAY - 30% finegrained sand. White - pale grey High plasticity.	S	S		
			30			END OF HOLE 30.0 Ft.				

TYPE OF SAMPLE	HYDROLOGY	CONSISTENCY	REL. DENSITY	MOISTURE		
Open Tube	Water cut	VS - Very Soft	VL - Very Loose	H - Humid	Plant No. 184	Logged Mason
Sealed Tube	Static level	S - Soft	L - Loose	D - Damp	Type GEMCO	Date 7 Mar 67
Core barrel	Supply	F - Firm	C - Compact	M - Moist	Driller Stummer	Drawn Mason
	Analysis (ppm)	ST - Stiff	D - Dense	W - Wet	Started 23 Feb 67	Traced JW
	← Water level	VST - Very Stiff	VD - Very Dense	S - Saturated	Finished 23 Feb 67	
					55780	

DEPT. OF MINES SOUTH AUSTRALIA

LOG OF AUGER DRILL HOLE 079

NO. 16

SHEET 1 OF 1

PROJECT SPRINGTON KAOLIN CLAY PROSPECT Hirer AUST. IND. MIN. LTD

LOCATION 3 MILES WEST SPRINGTON Sec 166 Hd PARA WIRRA

FEATURE

Depth 18 FT R.L. 996 Coords

Soil Type Geological Description		Casing R.L. (Feet)	Depth (Feet)	Graphic Log	Group Symbol	Soil Description Group Name	Consistency Rel. Density	Moisture Content	Water Levels	Remarks
PLEISTOCENE - RECENT HINDMARSH CLAY ?	TOPSOIL				SC	SAND - medium grained 20% clay. Dark Brown.	L	H		
	B Soil Horizon	990	5		CH	CLAY - high plasticity. Brown Khaki mottled. Few quartz pebbles 10-20 m.m. diameter.	H	H		
CAMBRIAN KANMANTOO GROUP Tertiary Weathering	Silica grains well rounded.		10, 15		SC	SAND - 15% clay. Low plasticity. White.	L	D		
	Silica grains well rounded	980			SC	SAND - 15% clay. Low plasticity. Yellow.	L	D		
						END OF HOLE 18.0 Ft				

TYPE OF SAMPLE	HYDROLOGY	CONSISTENCY	REL. DENSITY	MOISTURE
Open Tube	Water cut	VS-Very Soft	VL-Very Loose	H-Humid
Sealed Tube	Static level	S-Soft	L-Loose	D-Damp
Auger barrel	Supply	F-Firm	C-Compact	M-Moist
Slush pump	Analysis (p.p.m)	St-Stiff	D-Dense	W-Wet
	← Water level.	VSt-Very Stiff	VD-Very Dense	S-Saturated

Plant No 184
Type Gemco
Driller Stummer
Started 23 FEB 67
Finished 23 FEB 67

Logged MASON
Date 7 MAR 67
Drawn MASON
Traced J.W
Checked

PLAN S5781 Vertical Scale

LOG OF AUGER DRILL HOLE 080 ·

NO. 17
SHEET 1 OF 1

PROJECT SPRINGTON KAOLIN CLAY PROSPECT Hirer AUST. IND. MIN. LTD

LOCATION 3 MILES WEST SPRINGTON. Sec 166 Hd PARA WIRRA

FEATURE Depth 30 Ft R.L. 999 Coords

SOIL TYPE GEOLOGICAL DESCRIPTION		CASING R.L.(FEET)	DEPTH (FEET)	GRAPHIC LOG	GROUP SYMBOL	SOIL DESCRIPTION GROUP NAME	CONSISTENCY REL. DENSITY	MOISTURE CONTENT	WATER LEVELS	REMARKS
PLEISTOCENE - RECENT HINDMARSH CLAY III	TOPSOIL - Some organic matter.				SM.	SAND - 20% silt - fine grained. Dark brown.	VL.	H.		
	B Soil Horizon.		5		CH.	CLAY - 1% fine grained sand. High plasticity. Khaki and brown mottled.	V.St.	D		
CAMBRIAN - KANMANTOO GROUP Tertiary Weathering.	Kaolin Clay Well rounded Silica grains.				CH	CLAY - 5% fine grained sand. High plasticity. Red brown and grey mottled.	VSt.	D		KAOLIN CLAY SECTION. ↓
	Kaolin Clay - Well rounded Silica Kaolin Clay Probably in thin indurated bands.	1990	10, 15		CL	CLAY - 20% finegrained sand. Moderate plasticity. White.	H	H		
	Kaolin Clay.				CH	CLAY - 10% finegrained sand. Moderate plasticity. Pale Pink.	H	H	6 APRIL 67	
		1980, 1970	20, 25, 30		CH	CLAY - 2% fine grained sand High plasticity - Very Pale pink.	S	W		
						END OF HOLE 30·0Ft.				

TYPE OF SAMPLE	HYDROLOGY	CONSISTENCY	REL. DENSITY	MOISTURE		
Open Tube	Water cut	VS - Very Soft	VL - Very Loose	H - Humid	Plant No 184	Logged MASON
Sealed Tube	Static level	S - Soft	L - Loose	D - Damp	Type GEMCO	Date 7 MAR 67
Auger barrel	Supply	F - Firm	C - Compact	M - Moist	Driller Stummer	Drawn Mason
Slush pump	Analysis (p.p.m)	St - Stiff	D - Dense	W - Wet	Started 23 FEB 67	Traced JW
Casing	← Water level. (Date)	VSt - Very Stiff	VD - Very Dense	S - Saturated	Finished 23 FEB 67	Checked
					PLAN 55782	Vertical Scale

NO. 18

LOG OF AUGER DRILL HOLE 081

SHEET 1 OF 1

SPRINGTON KAOLIN CLAY PROSPECT — AUST. IND. MIN. LTD

3 MILES WEST SPRINGTON — Sec. 166 — PARA WIRRA.

Depth 24 FT R.L. 997 Coords

Stratigraphy	Soil Type / Geological Description	Casing	R.L. (Feet)	Depth (Feet)	Graphic Log	Group Symbol	Soil Description Group Name	Consistency / Rel. Density	Moisture Content	Water Levels	Remarks
PLEISTOCENE - RECENT HINDMARSH CLAY	TOPSOIL.					SC.	SAND - finegrained - 15% clay - Brown, Low plasticity.	L	H.		
	B soil horizon.			5		CH	CLAY - high plasticity Khaki and brown mottled.	H	H		
CAMBRIAN - KANMANTOO GROUP Tertiary Weathering.	Kaolin Clay.		1990			CH	CLAY - 5% medium grained sand. High plasticity. Pink and grey.	V.St	D		KAOLIN CLAY SECTION. ↓
				10		CH	CLAY - 2% medium grained sand. High plasticity White.	V.St	D	6 Apr 67	
	Silica grains well rounded.		1980	15		CL	CLAY - 40% fine to medium grained sand. Moderate plasticity Very pale brown.	St	M		
				20				S	W		
						SC	SAND - 40% clay Pale grey.	C	W		

END OF HOLE 24.0 Ft

TYPE OF SAMPLE	HYDROLOGY	CONSISTENCY	REL. DENSITY	MOISTURE		
Open Tube	Water cut	VS-Very Soft	VL-Very Loose	H-Humid	Plant No 184	Logged MASON
Sealed Tube	Static level	S-Soft	L-Loose	D-Damp	Type GEMCO	Date 7 Mar 67
Auger barrel	Supply	F-Firm	C-Compact	M-Moist	Driller Stummer	Drawn MASON
Hand pump	Analysis (ppm)	St-Stiff	D-Dense	W-Wet	Started 24 Feb 67	Traced JW
	← Water level.	VSt-Very Stiff	VD-Very Dense	S-Saturated	Finished 24 Feb 67	Checked
					PLAN 55783	

SPRINGTON KAOLIN CLAY PROSPECT — AUST.IND.MIN.LTD.

3 MILES WEST SPRINGTON — 166 PARA WIRRA.

082 L.997 Coords

Stratigraphy	Soil type	Elevation	Depth (ft)	Group symbol	Soil description / Group name	Consistency	Moisture		Remarks
PLEISTOCENE RECENT HINDMARSH CLAY ?	TOPSOIL.			SC.	SAND - finegrained - 15% clay - Brown, Low plasticity.	L	H		
	B soil horizon.	1990	5	CH	CLAY - high plasticity Khaki and brown mottled.	H	H		
CAMBRIAN - KANMANTOO GROUP Tertiary Weathering.	Kaolin Clay.			CH	CLAY - 5% medium grained sand. High plasticity. Pink and grey.	V.St	D		KAOLIN CLAY SECTION ↓
			10	CH	CLAY - 2% medium grained sand. High plasticity White.	V.St	D	6Apr67	
	Silica grains well rounded.	1980	15	CL	CLAY - 40% fine to medium grained sand. Moderate plasticity Very pale brown.	St	M		
			20			S	W		
				SC	SAND - 40% clay Pale grey.	C	W		

END OF HOLE 24·0 Ft

[illegible] SAMPLE	HYDROLOGY	CONSISTENCY	REL.DENSITY	MOISTURE		
[illegible] Tube	Water cut	VS Very Soft	VL Very Loose	H-Humid	Plant No 184	Logged MASON
[illegible] Tube	Static level	S-Soft	L-Loose	D-Damp	Type GEM 20	Date 7 Mar 67
[illegible] barrel	Supply	F-Firm	C-Compact	M-Moist	Driller Stummer	Drawn MASON
[illegible]	Analysis (ppm)	St Stiff	D-Dense	W-Wet	Started 24 Feb 67	Traced JW
	[illegible] Water level	VSt Very Stiff	VD Very Dense	S-Saturated	Finished 24 Feb 67	Checked
					55703	Vertical scale 1 inch = 5 Ft.

SERIAL NUMBER 399 REFERENCE OR DATE RECEIVED 11/1/67.
C.E. 2034.

LOCALITY Sec. 6367, Hd. Talunga, Jarvis pit, Birdwood, S.A.

MAP REFERENCE

DESCRIPTION Kaolin. 20 ft. channel sample taken down northwest face of pit. Washed sample (11.5% + 170 mesh material removed).

CHEMICAL ANALYSIS %		MINERALOGY %		PARTICLE SIZE (μ) Less than	%
SiO_2	51.5	Quartz	40	1	3.6
Al_2O_3	33.8	Kaolin	60	2	7.2
Fe_2O_3	0.14			3	10.5
FeO	0.08			4	13.0
MgO	0.16			5	15.6
CaO	0.10			6	18.5
MnO	< 0.01			7	21.4
Na_2O	0.07			8	23.6
K_2O	0.07			10	27.3
TiO_2	1.37			15	42.7
SO_3	0.17			20	57.9
Cl	0.05			25	74.5
CO_2	0.31			50	100
H_2O^+	12.4				

GRIT %

°C	IRREVERSIBLE THERM. EXP.	FIRING TEST Absorption	
800	-[illegible]		
850	-		
900	-3.0	33.1	Off-white
950	-	-	
1000	-4.5	31.6	Off-white
1050	-	-	
1100	-4.5	31.2	White
1150	-	-	
1200	-6.1	26.8	White

WET-TO-DRY CONTRACTION 5.0 % from 29.4% water

PLASTICITY Low

REMARKS

SERIAL NUMBER 400 REFERENCE OR DATE RECEIVED 11/1/67

084

C.D. 2035

LOCALITY Sec. 1635, Hd. Talunga - Cromer, S.A.

MAP REFERENCE

DESCRIPTION Kaolin. Sample taken from mouth of collapsed tunnel. Washed (15% + 170 mesh material).

CHEMICAL ANALYSIS %	
SiO_2	46.4
Al_2O_3	38.5
Fe_2O_3	0.06
FeO	0.15
MgO	0.14
CaO	0.29
MnO	< 0.01
Na_2O	0.07
K_2O	0.14
TiO_2	0.03
SO_3	0.34
Cl	0.03
CO_2	0.05
H_2O^+	13.6

MINERALOGY %	
Quartz	4
Kaolin	95
Illite-mica	1

PARTICLE SIZE (μ)	Less than %
1	2.1
2	6.5
3	10.5
4	15.4
5	20.8
6	27.6
7	33.3
8	37.9
10	47.8
15	65.8
20	87.1
25	100
50	100

GRIT %

°C	IRREVERSIBLE THERM. EXP.	FIRING TEST Absorption	
800	-		
850	-		
900	-2.0	23.8	Very pale pink
950	-	-	
1000	-3.5	23.2	Very pale pink
1050	-	-	
1100	-4.0	23.0	White
1150	-	-	
1200	-6.0	20.1	White

WET-TO-DRY CONTRACTION 3.0% from 27.6% water

PLASTICITY Non-plastic

REMARKS

SERIAL NUMBER 401 REFERENCE OR DATE RECEIVED 11/1/67. 085

C.E. 2036 Mining Review No. 113 (1962).

LOCALITY No.4 shaft, Cromer C, Sec. 140, Hd. Para Wirra, S.A. Sample taken from ceiling and rear wall of shaft.

MAP REFERENCE

DESCRIPTION Kaolin, product of kaolinisation of fractured grey wacke type rocks of the Kanmantoo Group of sediments. Outcrop is very poor. Washed sample (10% + 170 mesh material).

CHEMICAL ANALYSIS %		MINERALOGY %		PARTICLE SIZE (μ) Less than	%
SiO_2	46.4	Quartz	2	1	5.7
Al_2O_3	38.5	Kaolin	97	2	15.5
Fe_2O_3	0.26	Smectite	1	3	39.3
FeO	0.10			4	53.4
MgO	0.17			5	63.4
CaO	0.17			6	68.1
MnO	$<$0.01			7	70.7
Na_2O	0.12			8	77.9
K_2O	0.03			10	84.2
TiO_2	0.21			15	84.2
SO_3	0.28			20	84.2
Cl	0.13			25	88.1
CO_2	$<$0.01			50	100
H_2O^+	13.6			GRIT %	

°C	IRREVERSIBLE THERM. EXP.	FIRING TEST Absorption	
800	-		
850	-		
900	-2.2	54.7	Pale pink
950	-	-	
1000	-4.1	50.9	Pale pink
1050	-	-	
1100	-4.6	50.2	White
1150	-	-	
1200	-9.8	38.4	White

WET-TO-DRY CONTRACTION 5.0 % from 40.8 % water

PLASTICITY Low

REMARKS See also samples CE 3098/9 - sample of pin[k] stained clay from No 3 shaft which fired white.

RESULTS OF CERAMIC INVESTIGATION OF KAOLIN CLAY

Section 166, Hd. PARA WIRRA - SPRINGTON

Carried out by Ceramics Section, AMDEL

A. Composite Sample. Ref. A.1313/67 (Sample No.)
Report CE.2347/67

Hole No.	From	To	Hole No.	From	To
1	6.0	34.0	10	4.0	22.0
2	4.0	36.0	11	3.0	30.0
3	7.0	23.0	12	6.0	30.0
4	(6.0	21.0	13	(7.0	24.0
	(28.0	36.0		(25.0	30.0
5	17.0	19.5	15	(5.0	9.0
6	(12.0	17.0		(20.0	30.0
	(19.0	30.0	17	(8.0	16.0
7	10.0	15.0		(18.0	30.0

Date: 12th April, 1967

PRELIMINARY FIRING TEST

The sample as received was a cream colour, and the request for full ceramic investigation, if warranted, suggested that the use of this material in whiteware was envisaged. The sample was therefore prepared by washing, a procedure that would not be used for brick clays.

Sample Preparation

1300 g. of the sample were mixed with 10 l. of distilled water. The mixture was screened on a 170-mesh BSS screen. The oversize material was dried and weighed and amounted to 28.5% of the original sample. The undersize was allowed to settle, 1.5 l. of water were syphoned off, and the residue was dried on a plaster slab to a suitable moisture content for extrusion.

Extrusion

The prepared sample was extruded non-de-aired at 25.0% moisture. The extruded column was smooth, weak and of low plasticity. Core cracks developed in specimens cut from the extruded column after drying at room temperature for 16 hours. The cracks increased on further drying at 40°C for 8 hours and 105°C for 16 hours. The drying shrinkage was 6.0%.

Firing Test

The dry specimens were fired in 50°C steps over the range 800-1200°C, and a set of fired specimens is submitted to indicate the fired appearance. Measurements of firing shrinkage and 24-hour cold water absorption were made on the fired specimens, and the results are shown in the table.

Temp. °C	Firing Shrinkage %	Cold Water Absorption, %	Remarks
800	1.0	23.2	Pink, slightly chalky, core cracks
850	1.6	22.2	do.
900	2.1	22.1	"
950	2.6	21.8	Pink, hard, core cracks
1000	3.1	21.2	do.
1050	4.2	17.9	"
1100	9.5	8.7	"
1150	10.5	5.9	Light brown, hard, core cracks.
1200	11.8	2.0	Light brown, hard, vitrified, core cracks.

Conclusions

This clay is not suitable for use in whiteware, owing to its fired colour. It might, however, find application in the heavy day industry, particularly for the manufacture of building bricks. The small sample submitted has all been used, so that no further tests can be made, but if a brick-making clay is required in the area, this material would be worth further investigation.

RESULTS OF CERAMIC INVESTIGATION OF KAOLIN CLAY

Section 166, Hd. PARA WIRRA - SPRINGTON

Carried out by Ceramics Section, AMDEL
Report CE.2406/67

1. CE.2077 (A.1353/67)
White High grade Clay.

Hole No.	Composite Sample From Depth From	To
1	6.0	10.0
2	4.0	15.0
3	7.0	23.0
4	6.0	21.0
8	10.0	15.0
13	7.0	12.0
15	5.0	9.0
17	8.0	16.0

2. CE.2078 (A.1354/67)
Brown Kaolin Clay.

Hole No.	Composite Sample From Depth From	To
1	10.0	34.0
2	25.0	36.0
4	28.0	36.0
6	19.0	30.0
10	4.0	22.0
11	3.0	30.0
12	6.0	30.0
13	25.0	30.0
15	20.0	30.0
17	18.0	30.0

March, 1967

TESTING OF CLAYS

Preliminary Firing Test

(1) CE2077

The material was ground with some difficulty to minus 18-mesh BSS, and contained a fairly high proportion of coarse grit.

The sample absorbed water readily, and was extruded non-de-aired at 27.4% moisture content to form a weak column, low in plasticity and free from dog ears or cracks. The material dried without cracking after 16 hours at room temperature, 8 hours at 40°C, and 16 hours at 105°C. Drying shrinkage (at 27.4% moisture content) = 4.0%. Cylindrical specimens were cut from the extruded columns and fired in 50°C steps from 800°C to 1200°C. Firing shrinkage and 24-hour cold water absorption measurements were carried out on the fired specimens and the following results obtained.

Temp. °C	Firing Shrinkage %	24-hour Cold Water Absorption, %	Comments
800	0.5	29.6	Pale pink, chalky
850	0.5	29.6	" " "
900	0.5	29.2	" " "
950	2.5	28.6	" " "
1000	2.5	28.6	" " "
1050	2.5	28.2	Cream, hard
1100	3.0	25.6	" "
1150	7.2	17.6	" "
1200	10.2	12.4	" "

Two sets of specimens are supplied showing the fired colour and temperature range.

(2) CE2078

The material ground easily to minus 18-mesh BSS and contained a small amount of fine grit.

The sample absorbed water readily, and was extruded non-de-aired at 23.2% moisture content to form a very weak, short column, low in plasticity and free from dog-ears or cracks. The material dried without cracking after 16 hours at room temperature, 8 hours at 40°C, and 16 hours at 105°C.

Drying Shrinkage (at 23.2% moisture content) = 6.5%. Cylindrical specimens were cut from the extruded columns and fired in 50°C steps from 800°C to 1200°C. Firing shrinkage and 24-hour cold water absorption measurements were carried out on the fired specimens and the following results obtained.

Temp. °C	Firing Shrinkage %	24-Hour Cold Water Absorption, %	Comments
800	1.3	20.7	Light red, slightly chalky.
850	1.3	19.4	do.
900	1.3	19.0	"
950	1.3	19.0	Light red, hard
1000	1.3	18.5	do.
1050	3.6	15.6	"
1100	6.2	9.3	"
1150	7.7	6.7	Dark grey, hard
1200	9.8	3.3	Brown grey, hard

Two sets of specimens are supplied showing the fired colour and temperature range.

Alumina Content

The determination of alumina was carried out by our Analytical Section, and the following results obtained.

		Percentage Alumina
Sample (1)	CE2077	29.1
Sample (2)	CE2078	25.4

Pyrometric Cone Equivalent

A representative sample of the materials was prepared and tested according to the procedure set out in ASTM Designation C.24-56, and the following results obtained:

Sample	Pyrometric Cone Equivalent	Equivalent Temperature
(1) CE2077	Cone 28	1646°C
(2) CE2078	" 18	1522°C

Conclusions

The white clay (2077) may be suitable for refractory use and it is possible that a high grade refractory clay could be obtained from the material by washing.

The brown clay (2078) would not be suitable for use in refractories. It could probably be used for the manufacture of light coloured building bricks fired at 950°C.

Testing of sample from bulldozer cut, Section 166, Hd. Para Wirra carried out fr Australian Industrial Minerals N.L. by Nonporite Pty. Ltd., Melbourne.

Assay for Alumina by R. Gluyas 38.4% Al_2O_3.

WHITE CLAY

Further to our letter of the 9th September relative to the sample of white clay you forwarded to us for test, we now have pleasure in reporting as follows:-

Fusion Point - Standard Orton Cone 34 = 1760°C
= 3200°F

Screen Analysis - (Washed sample as received)

Retained	2/8	8.5%
	1/4	5.6
	3/16	3.9
	8	16.6
	22	18.1
	44	8.4
	85	9.8
	100	1.6
	200	0.2
	-200	26.8

The washing method of screen analysis indicates the low slaking characteristic of the material.

Induration has taken place - possibly hydrothermal - causing hardening with resulting low plasticity characteristics.

Screen Analysis of representative sample of the clay ground to -80 mesh.

- 85 +	100	=	2.4
+	200		24.0
-	200		73.6

The clay could be readily ground in a closed circuit disintegrator mill to the degree of fineness desired.

Moisture Content = 1.75%
Ignition Loss = 11.2%

This indicates that the clay - a kaolinite type is in a hydrated form.

Shrinkages - Linear - Wet to dry = 0.5%
Dry to fired 1400°C. = 13.4%

~~The~~ relative high shrinkage is characteristic of Kaolinite clays.

Workability & Plasticity - 100 parts of the ground clay and 15 parts of water by weight gave a slightly plastic mouldable mix.

Conclusions - Based on the above the clay is essentially a Kaolinitic type of relatively low plasticity, low flux and impurity content and high refractoriness and should prove effective in Ceramic product applications where a Kaolin of this type is applicable.

APPENDIX 3

CERAMICS INVESTIGATION

Carried out by Ataka (Aust.) Pty. Ltd.
for Aust. Industrial Minerals N.L.

Sample from bulldozer trench.

Section 166, Hd. Para Wirra

December, 1966.

WHITE CLAY

TEST RESULT

Refractriness (S.K.) 35

Mineral Composition: Kaolinite

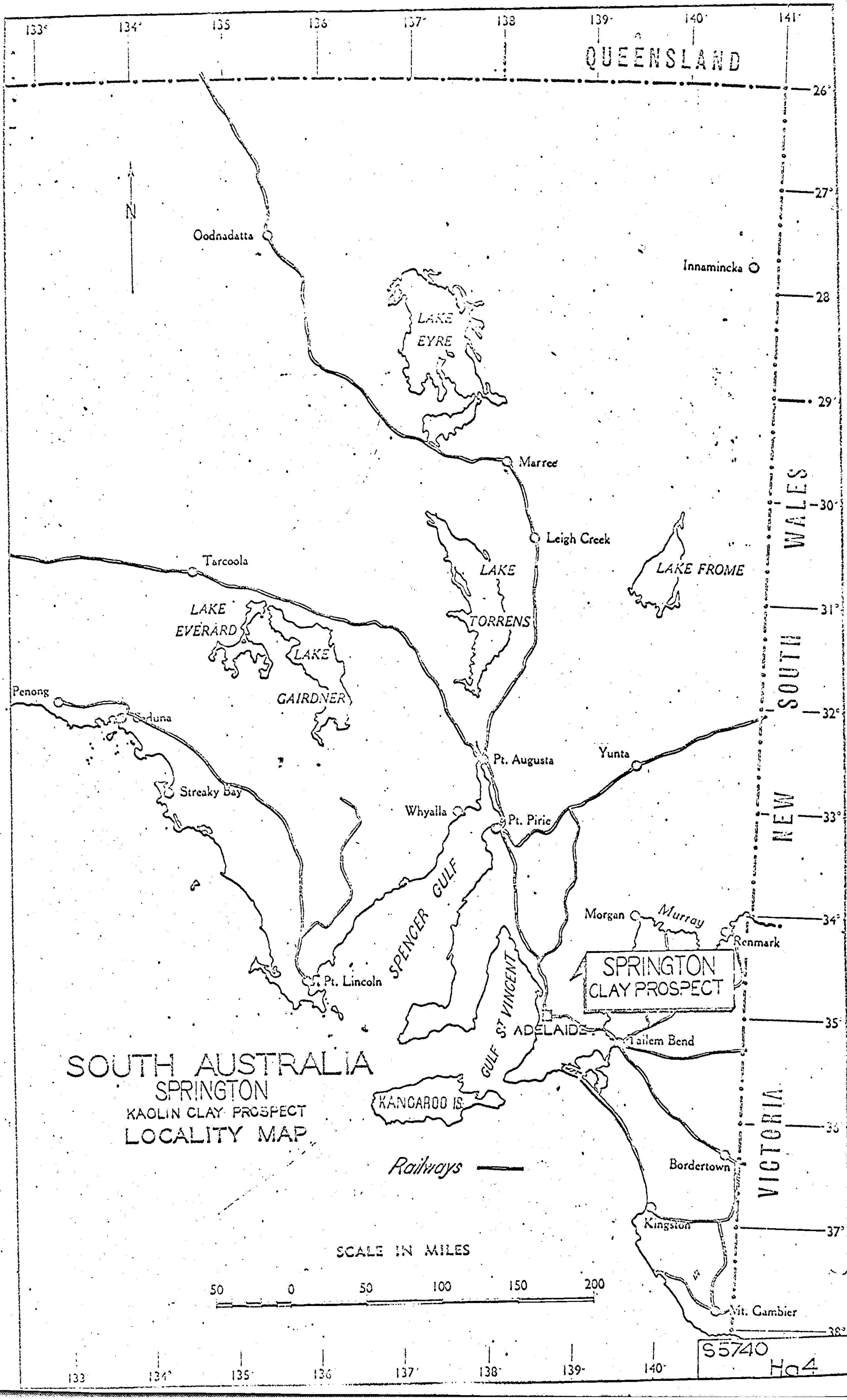
Appearance: From visual inspection the sample shows in colour of white/grey-white. Is conform to clay composed with a fine material of under 5 cm. in size and shows colour of white/grey-white.

Burning Test:

Ig. loss	14.3%
Linear contraction co-efficiency	16.7%
Porosity	15.3%
Bulk Density	2.27%

Appearance: White in colour
No iron spot can be found
Slight cracks.

tested by "Elema" Electric Furnace
1350°C x 2 hrs.


QUEENSLAND
NEW SOUTH WALES
VICTORIA
Oodnadatta
Innamincka
LAKE EYRE
Marree
Leigh Creek
LAKE TORRENS
LAKE FROME
Tarcoola
LAKE EVERARD
LAKE GAIRDNER
Penong
Ceduna
Streaky Bay
Pt. Augusta
Yunta
Whyalla
Pt. Pirie
SPENCER GULF
Pt. Lincoln
Morgan
Murray
Renmark
SPRINGTON CLAY PROSPECT
GULF ST VINCENT
ADELAIDE
Tailem Bend
KANGAROO IS.
Bordertown
Kingston
Mt. Gambier
N
SOUTH AUSTRALIA
SPRINGTON
KAOLIN CLAY PROSPECT
LOCALITY MAP
Railways
SCALE IN MILES
50 0 50 100 150 200
133° 134° 135 136 137° 138 139° 140° 141°
26° 27° 28 29° 30° 31° 32° 33° 34° 35° 36 37° 38°
S5740
Ha4

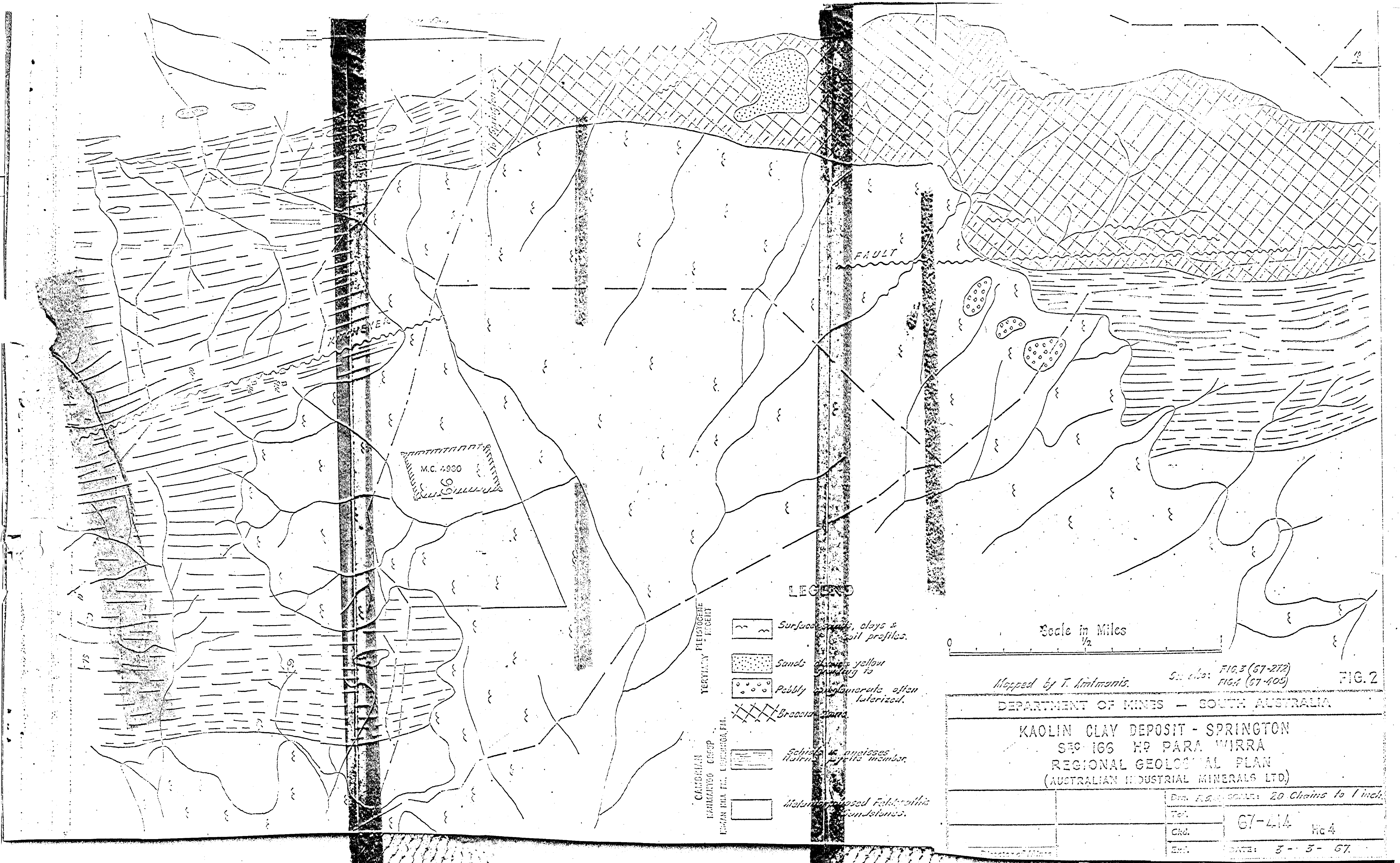


FIG. 2

ENV 1082(1) - S

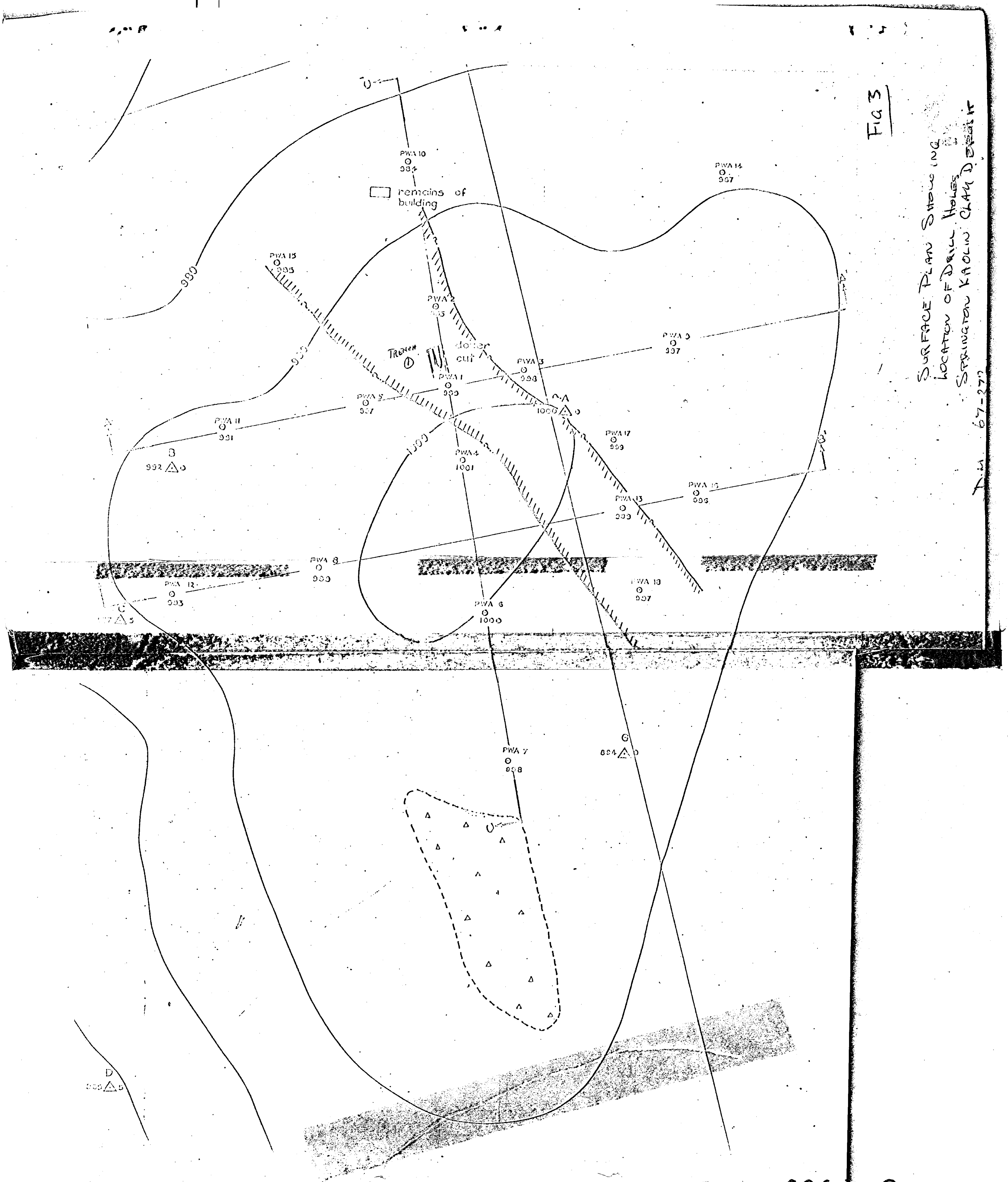
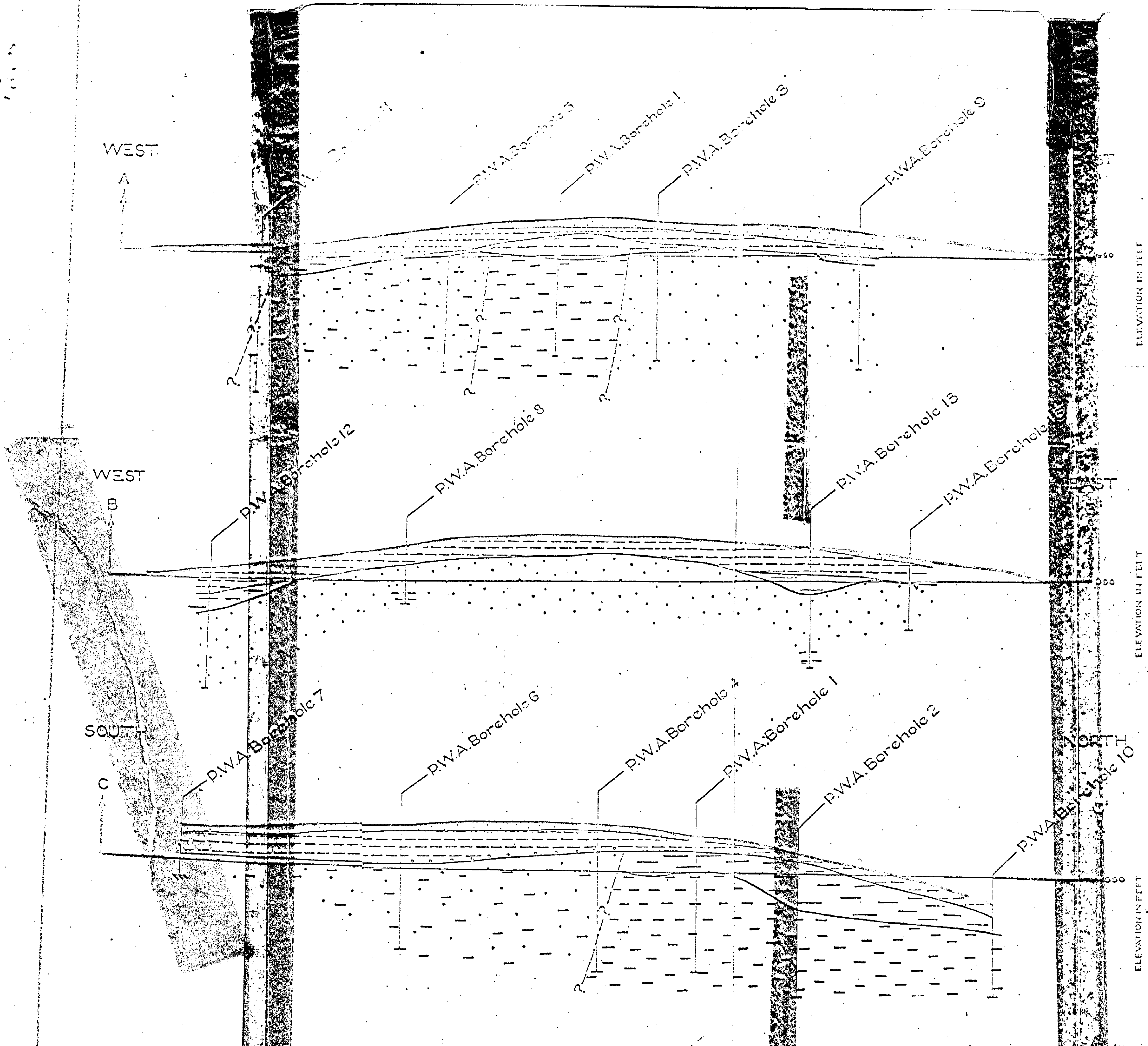


FIG 3
SURFACE PLAN SHOWING LOCATION OF DRILL HOLES SPRINGTON KAOLIN CLAY DEPOSIT
D.M. 67-27?
remains of building
PWA 10
PWA 14
997
PWA 15
PWA 2
Trench ①
dozer cut
PWA 3
998
PWA 9
997
PWA 1
PWA 5
997
PWA 11
991
B
992
1000
PWA 17
PWA 4
1001
PWA 16
PWA 13
PWA 8
PWA 12
993
PWA 18
997
PWA 6
1000
C
PWA 7
G
994
D
990
1000

ENV 1082(1)-3



LEGEND

PLEISTOCENE-RECENT HINDMARSH CLAY EQUIVALENT

- Brown fine grained sand. 15% Clay.
- Khaki and brown mottled, high plasticity clay. Often pebbles at base

CAMBRIAN-KANMANTOO GROUP TERTIARY WEATHERING

- White high plasticity kaolin clay.
- Sand – about 30% clay content. Clay – 40 to 50% content. (Often pale brown.
- Clay – yellow brown, high plasticity – 5 to 15% sand

SCALE

Horizontal : 100 feet to 1 inch
Vertical : 25 feet to 1 inch

See also Fig 2 – 67–414
Fig 3 – 67–272

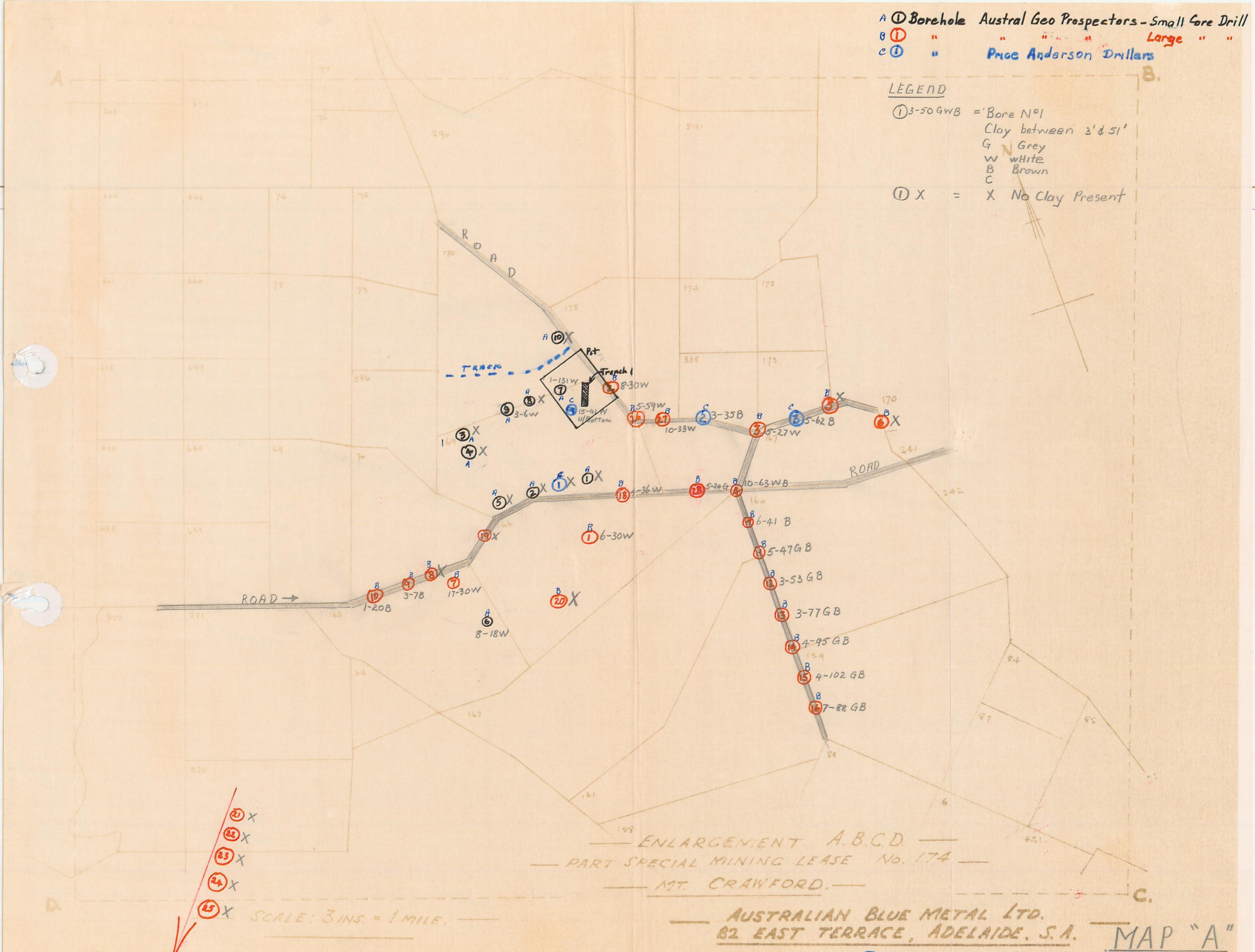
FIG. 4

DEPARTMENT OF MINES — SOUTH AUSTRALIA

SPRINGTON KAOLIN CLAY PROSPECT
SECT. 100 HD PARA WIRRA
GEOLOGICAL CROSS SECTIONS.

Drn. M.G.M.	SCALE AS SHOWN
Tcd. G.M.	67-405 H04
Ckd. L.V.W.	
	DATE: 8-6-67

ENV 1082(1) – 4



A ① Borehole Austral Geo Prospectors - Small Core Drill
B ① " " " " Large " "
C ① " Price Anderson Drillers
LEGEND
① 3-50 GWB = 'Bore N° 1
Clay between 3' & 51'
G Grey
W wHite
B Brown
C
① X = X No Clay Present
ROAD
TRACK
Pit
Trench 1
1-131W
15-41W
U/Bottom
8-30W
5-59W
10-33W
3-35B
5-27W
5-62B
3-6W
10-63WB
5-24G
4-36W
6-41 B
5-47GB
6-30W
3-53 GB
3-77GB
4-95 GB
4-102 GB
7-88 GB
1-20B
3-7B
17-30W
8-18W
ROAD →
ROAD
ENLARGEMENT A.B.C.D
PART SPECIAL MINING LEASE No. 174
MT. CRAWFORD.
SCALE: 3 INS. = 1 MILE.
AUSTRALIAN BLUE METAL LTD.
82 EAST TERRACE, ADELAIDE. S.A.
MAP "A"

ENV 1082(1)-2

SUMMARY OF MT CRAWFORD CORE DRILLING.

DRILLING PERIOD 26 SEPT 68 TO 4 NOV 68.

DRILLING RIG	FOOTAGE DRILLED.
AUSTRAL GEO PROSPECTORS' LARGE RIG (FAILING 1500).	1921' 6"
" " " SMALL " (" 200).	557' 10"
PRICE ANDERSON'S ODGERS RIG	192' 6"
	2671' 10"

AUSTRAL GEOPROSPECTORS

CUMULATIVE FOOTAGE.
24'

BOREHOLE NUMBER 99,000E/100,000 N. (AUSTRAL GEO) AGP1

Spudded in 1 p.m. 26th September, 1968

DEPTH DRILLED	CORE RECOVERED	REMARKS
0 - 6'	Not cored	Brown red lateritic soil.
6' - 7'3"	7"	Compact core - grey white clay with red specking and iron stained joint surfaces.
7'3" - 8'6"	2"	Material as above.
8'6" - 9'9"	3"	Brown red laterite - probably fallen down hole.
9'9" - 11'0"	1' 3"	Good white clay somewhat sandy. Slight iron staining upper part.
11'0" - 12'3"	1' 3"	White clay with red iron specking.
12'3" - 13'6"	1' 1"	Greenish clay with heavy iron staining.
13'6" - 14'9"	10"	Greenish clay with iron specking.
14'9" - 16'0"	1' 2"	Greenish clay with iron staining upper part.
16'0" - 17'3"	3"	Water at this level. Off white clay with iron specking.
17'3" - 18'6"	10"	Greenish white clay with small black flecks.
18'6" - 19'9"	1' 0"	as above.
19'9" - 24'0"	1' 6"	White kaolinised sandstone, very friable with heavy iron staining in veins.

Total cored 18' - 0"

Total recov.
10' 2".
% Recovery 57.

C.F. 73

BOREHOLE NUMBER 99000E/100,000 N (A.G.P. 1) ctd.

27th September, 1968

DEPTH DRILLED	CORE RECOVERED	REMARKS
24' - 25'	9"	Off white clayey sandstone, red and black specking.
25' - 29'	3' 10"	Soft core, grey kaolinised sandstone, greenish in lower part.
This portion about 29' redrilled (PTO)		
29' - 34'	5' 0"	2'6" greenish clayey sandstone 2'6" brown yellow clayey sandstone.
34' - 42'	4' 11"	Upper part brown yellow clay with greyish lower part.
42' - 44'	2' 0"	Variegated yellow, grey and pink sandstone.
44' - 47'	3' 0"	Pink, grey and yellow sandstones.
47' - 56'	1' 11"	Pale green thixotropic mud during drilling. Solid core shows off white sandstone with plentiful green veinlets.
50' - 59'	3' 10"	Light green sand slurry upper part. Lower part white and green sandstone.
59' - 64'	2' 8"	Grey green kaolinised sandstone with slight iron staining in lower part.
64' - 69'	4' 5"	Green brown slurry upper part. Core of hard greenish quartzite slightly altered.
69' - 71'	1' 10"	Hard whitish quartzite with 1/4" dark bands. Changed to diamond bit; truck engine packed up 4 p.m.
71' - 73'	2' 0"	Green banded quartzite, very hard. Hole stopped - diamond bit ruined.

Recovery from 29' - 73' was 31'7" i.e. 72%

---- 3 ---- C.F. 102'6"

BOREHOLE NUMBER 99000E/100,000N (AGP1 REDRILL)

DEPTH DRILLED	CORE RECOVERED	REMARKS
		Commenced 13.00 (28/9/68) Finished 16.30 (28/9.68)

Drill moved 10 ft. to north of peg and the top 30' was redrilled.

0 - 3'6"	Not cored	Red lateritic overburden.
3'6" - 4'6"	1' 0"	White clay badly iron stained.
4'6" - 5'6"	11"	As above.
5'6" - 6'6"	8"	Off white compact clay, some tree roots.
6'6" - 8'0"	1' 0"	Off white clay.
8'0" 0 9'6"	1' 0"	Off white clay.
9'6" - 11'0"	1' 2"	" " " with iron specking.
11'0" - 12'6"	1' 2"	" " clay with slight green specking.
12'6" - 16'6"	2' 4"	Off white sandy clay, minor iron specking.
16'6" - 19'6"	2' 7"	Off white clay, increasing green veining.
19'6" - 29'6"	10' 0"	Greenish white clay, plastic, lower and middle portions with some brown iron stained patches.

Total cored = 26'0" 21' 10"

= 85% recovery — 1F top 3'6" which was not cored is taken as 100% recovery, - then recovery = 77.5%.

Total hole = 70'0" 53' 5"
= 76% recovery

Sampling for despatch.

0 - 6'6" - badly ironstained, classified as overburden.

6'6" - 19'6")
19'6" - 29'0") left Williamstown House 5/10/68.
29'0" - 42'0")

C.F. 209'6"

BOREHOLE NUMBER 99418E/101000N (AGP2)

Started approx. 09.30 3/10/68

DEPTH DRILLED	CORE RECOVERED		REMARKS
0 - 3'	Not cored		Overburden
3' - 4'6"	1'	2"	Hard siliceous sandstone off white with variable iron staining and fine black flecking
4'6" - 5'6"	10"		Hard siliceous sandstone as above.
5'6" - 6'6"	1'	0"	Brown yellow friable sandstone, bottom 4" iron stained white hard sandstone.
6'6" - 8'0"	1'	4"	Buff coloured very hard siliceous sandstone; 10" black mineral banded clayey sandstone - medium hard. 3" soft white clayey sandstone.
8'0" - 9'6"	1'	3"	Buff coloured clayey sandstone (dries white).
9'6" - 11'0"	1'	3"	Softish white clayey sandstone. Lower part hard with more clay bands.
11'0" - 14'6"	2'	2"	White medium hard clayey sandstone.
14'6" - 20'6"	5'	2"	Soft white clayey sandstone. Some fine black flecking in top middle sections.
20'6" - 27'6"	6'	7"	
27'6" - 31'0"	2'	5"	White soft friable sandstone.
31'0" - 44'0"	6'	10"	4" quartz stringer 3' soft cream friable sandstone.
44'0" - 46'0"	2'	2"	1'6" soft cream clay 6" iron stained clay band.
46' - 49'6"	3'	6"	1' sandy white clay followed by greenish white clay then 1' brown clay back into cream clay.
49'6" - 54'6"	5'	0"	1' buff sandy clay, 3' white sandy clay. 1' yellowish brown clay.

CF. 209'6"

- 5 -

BOREHOLE NUMBER 99418/101/000N (AGP2) ctd.

DEPTH DRILLED	CORE RECOVERED	REMARKS
54'6" - 61'0"	5' 6"	3' buff friable sandstone with 2' cream sandy clay.
61' - 67'	2'	1'6" buff sandy material 7" white clayey sand.
67' - 73'[illegible]"	2' 6"	White sandy material
73' - 77'6"	3' 2"	1'1" white hardy clayey sandstone, remainder buff sandy material.
77'6" - 86'	5' 0"	9" white medium soft clayey sandstone. 14" buff stained sandy clay. 1' white sandy material. Remainder white to offwhite sandy clay.
86' -88'	2' 0"	6" buff cream sandy clay, 2" cream clay, 1'4" buff sandy clay.
88' - 92'	3' 4"	Cream/buff sandy material - medium soft last 8" hard.
92' - 98'	4' 8"	8" buff sandy material, 2" dark banding with iron staining above and below. Remainder white quartzite flecked with green. Last 1' white hard clay.
98' - 105'	6' 4"	3' cream medium hard sandy material. 1' soft sandy clay. 1' cream quartzite hard, remainder white sandy material
105' - 107'	2' 0"	Cream white sandy material, 6" hard quartz bands, remainder hardish quartzite.

-------2.00 p.m. finish 4/10/68

Total 107 80' 2"

<u>Recovery 75%</u>

Sampled for despatch: 8'6" - 22'; 22'0"-21'0"; 31'0-48'0; 48'-59'; 59' - 75'; 75' - 91'; 91' - 101'; 101' - 107'.

C.F. 257'0".

BOREHOLE NUMBER 1003 65E/100500N (AGP3)

commenced 3 p.m. 4/10/68

DEPTH DRILLED	CORE RECOVERED	REMARKS
0 - 11'	Not cored	Overburden.
11' - 13'6"	2' 1"	Top: medium-hard off white sandstone; Lower: hard white quartzite with 1/2" wide quartz vein; slight iron staining throughout.
13'6" - 15'0"	10"	Quartzite & quartz fragments in brown clay matrix.
15'0" - 16'0"	8"	Medium hard white clayey sandstone.
16'0" - 19'0"	Not cored	Rock bit through hard white quartzite.
19'0" - 23'0"	3' 6"	Hard to medium-hard white clayey sandstone with bands of orange, green and brown staining.
23'0" - 27'0"	3' 3"	Hard to friable white clayey sandstone with some iron staining.
27'0" - 30'6"	2' 10"	Hard quartzite with some clay and strong green and black flecking with severe iron staining.
30'6" - 32'0"	1' 0"	Hard white quartzite.
32'0" - 33'0"	7"	Quartzite with dark mineral and severe iron staining.
33'0" - 36'0"	Not cored	Hard quartzite: buff coloured rock chips.
36'0" - 39'6"	3' 6"	Hard & soft grey green quartzite with minor brown clay bands.
39'6" - 40'6"	3"	Medium hard buff clayey quartzite.
40'6" - 46'6"	Not cored	Hard buff-white quartzite.
46'6" - 47'6"	10"	Medium hard green quartzite followed by hard grey quartzite

----finished 10 a.m. 5/10/68

Total 47'6" 42'10" Recovery 90%. ~~Sample stored~~ - ~~none~~ despatched

C.F. 332'

BOREHOLE NUMBER 100,000E/100,000N (AGP4)

commenced 12.00 hours 5/10/68

DEPTH DRILLED	CORE RECOVERED	REMARKS
0 - 5'0"	Not cored	Overburden
5'0" - 6'6"	1' 2"	Iron stained subsoil
6'6" - 8'0"	11"	" " "
8'0" - 9'6"	1' 3"	Badly iron stained white clay
9'6" - 11'0"	1' 3"	Slight iron " white clay
11'0" - 19'0"	7' 8"	2' white clay, 1' buff clay, remainder white clay sand-stone.
19'-0" - 29'6"	8' 6"	White clay sandstone.
29'6" - 34'0"	4' 1"	White clay sandstone.
34'0" - 36'0"	Drilled off	Quartz vein
36'0" - 40'0"	8' 10"	4' white clay, 4'10" badly stained.
46' - 49'0"	3' 0"	Orange brown stained clay.
49'0" - 54'6"	2' 5"	Orange brown stained clay
54'6" - 55'6"	1' 0"	Buff soft clay
55'6" - 58'6"	1' 8"	Quartz vein - then badly stained clay
58'6" - 62'6"	10"	Brown sandy clay with quartz vein
62'6" - 63'0"	1' 0"	Soft buff sandy friable clay
63'6" - 66'0"	1' 0"	Hard brown clay sandstone
66'0" - 75'0"	4' 8"	Orange brown clay passing down into massive grey banded quartzite
		Finished Monday 7/10/68
75'0"	57' 3"	

Recovery 76.5%

Sampled for despatch
9'6" - 22'6"
22'6" - 39'0"

C.F. 399'0"

BOREHOLE NO. 100,875E/100,500N (AGP5)

Commenced 7/10/68

DEPTH DRILLED		CORE RECOVERED	REMARKS
0 - 13'6"		Drilled off	Hard sandstone capping and overburden
13'6"		2' 7"	Light brown stained sandstone
16'6"	- 22'0"	3' 6"	Buff cream sandstones
22'0"	- 26'0"	4' 0"	Light brown sandstone
26'0"	- 27'6"	1'·6"	Brown sandstone with quartz vein
27'6"	- 32'6"	2' 5"	Hard brown sandstone
32'6"	- 34'6"	2' 0"	Variably stained sandstone
34'0"	- 37'6"	3' 2"	Light brown sandstone grading through to quartzite stained pink and green
			Finished 12.00 hours 8/10/68
37'6"		32' 8"	
		% Recovery 85	Samples stored.

C.F. 399'0"

BOREHOLE NUMBER 101,085E/100,200N (AGP6)

Commenced 13.00 hours 8/10/68

DEPTH DRILLED	CORE RECOVERED	REMARKS
0 - 16'6"	Drilled off	Buff hard sandstone
16'6" - 20'6"	2' 9"	Brown biotite muscovite sandstone grading with quartz mica schist
20'6" - 23'6"	2' 5"	Light brown friable mica quartzite with hard quartzite lower part
23'6" - 25'0"	1' 5"	Hard iron stained micaceous quartzite
25'0" - 27'6"	2' 6"	as above
27'6" - 29'6"	9"	Hard mica quartzite

Finished 14.30 8/10/68

29'6"	26' 4"	Samples stored

Recovery 89%

C.F. 480'6"

BOREHOLE NO. 97,900E/100,000N (AGP7)

Commenced 08.30 9/10/68
Finished 16.30 9/10/68

DEPTH DRILLED	CORE RECOVERED	REMARKS
0 - 1'6"	Not cored	Overburden
1'6" - 16'6"	11' 9"	Brown and buff sandstone & clayey sandstone
16'6" - 24'6"	4' 9"	Offwhite & buff clay sandstones
24'6" - 29'6"	5' 0"	4' offwhite clay sandstone 1' badly iron stained sandstone
29'6" - 37'6"	7' 0"	Badly iron stained micaceous sandstone
37'6" - 40'6"	3' 0"	As above
40'6" - 47'6"	4' 6"	As above, becoming less heavily stained in lower part
47'6" - 56'0"	4' 6"	Quartz vein, below buff silica sand
56'0" - 62'6"	5' 3"	Upper part badly stained friable quartz mica sandstone. Lower part off-white to buff friable mica quartzite
62'6" - 71'0"	3' 8"	Buff quartz rich friable sandstone
71'0" - 77'6"	5' 9"	Grey & buff friable sandstone
77'6" - 81'6"	2' 0"	White to green friable sandstone becoming massive in lower part
81'6"	58' 8"	Sampled for despatch 16'6" - 26'6"

Recovery 72%

C.F. 525'6"

BOREHOLE NO. 97,750E/100,050N (AGP8)

Commenced 08.30 10/10/68

Finished 14.30 10/10/68

DEPTH DRILLED	CORE RECOVERY	REMARKS
0 - 3'	Not cored	Laterite overburden
3' - 4'6"	1' 4")	Brown sandy clay
4'6" - 6'0"	1' 2")	
6'0" - 7'6"	1' 4"	Brown white sandy clay
7'6" - 9'0"	1' 0"	Buff sand
9'0" - 10'6"	1' 0"	as above
10'6" - 12'0"	1' 0"	White sandstone iron stained
12'0" - 18'0"	5' 9"	Grey white sandstone with biatite flakes
18'0" - 21'6"	1' 6"	as above
21'6" - 27'0"	1' 8"	Iron stained quartzite
27'6" - 32'6"	4' 6"	as above
32'6" - 41'6"	8' 6")	Iron stained quartzite becoming very massive with green discolouration.
41'6" -45'0"	3' 6")	
45'0"	35' 3"	

Recovery 77% Sample stored

C.F.
566'6"

BOREHOLE NUMBER 97,500E/100,060N (AGP9)

commenced 15.30 10/10/68
finished 09.30 11/10/68

DEPTH DRILLED	CORE RECOVERED	REMARKS
0' - 3'	Drilled off	Overburden
3' - 4'6"	1' 4"	Brown & white sandy clays
4'6" - 6'0"	1' 4"	Off white sandy clay
6'0" - 7'6"	1' 4"	Soft brown clay
7'6" - 9'6"	1' 10"	Brown mottled white clay grading into hard iron-stained quartzite.
9'6" - 11'0"	1' 5"	Brown orange friable clay sandstone with biatite mica.
11'0" - 19'6"	7' 4"	Buff sandy clay with some white veining, biatite mica evident throughout.
19'6" - 29'0"	1' 0"	White sandy friable material
29'0" - 37'6"	7' 3"	Brown sandy clays grading into brown quartzites
37'6" - 41'0"	3' 3"	Brown red quartzite with biatite mica
		Hole stopped 09.30 11/10/68
41'0"	29' 1"	

<u>71% recovery</u> Samples stored

C . F. 606'6"

BOREHOLE NUMBER 97,250E/100,080N (AGP10)

commenced 10.30 11/10/68
finished 15.30 11/10/68

DEPTH DRILLED	CORE RECOVERED	REMARKS
0' - 1'6"	Not cored	Overburden
1'6" - 2'6"	8"	)
2'6" - 3'6"	11"	)Brown iron stained clay sand
3'6" - 5'0"	1' 2"	)
5'0" - 6'0"	10"	)
6'0" - 7'6"	1' 3"	)Brown soft clayey sandstone
7'6" - 9'0"	1' 2"	)
9'0" - 10'6"	1' 3"	)
10'6" - 16'0"	3' 0"	Severely stained white clay sandstone with thin clay veins
10'0" - 19'6"	1' 7"	Brown soft sands
19'6" - 21'0"	1' 6"	5" white clay associated with quartz vein. Rest soft brown clay sandstone.
21'0" - 27'6"	6' 0"	Brown clay sandstone
27'6" - 34'0"	5' 10"	Brown micaceous soft clay sandstone
34'0" - 40'0"	5' 0"	Brown micaceous soft clay sandstone
40'0"	39' 8"	

79% Recovery

Samples stored

C.F. 673'0"

BOREHOLE NUMBER 100,010E/99,506N (AGP11)

commenced 16.00 hours 11/10/68
finished 14.00 12/10/68

DEPTH DRILLED	CORE RECOVERED	REMARKS
0 - 5'	Not cored	Brown grey sandstone. Cased to 6'.
5'0" - 6'6"	1' 3"	Ironstained grey plastic sandy clay
6'6" - 8'0"	1' 3"	Iron stained grey plastic sandy clay
8'0" - 9'6"	1' 2"	Iron stained grey plastic sandy clay
9'6" - 11'0"	9' 2"	Iron stained grey plastic sandy clay
11'0" - 25'0"	9' 11"	Quartz vein at 11'8" and 12'5". From 17' only slight iron staining.
25'0" - 33'6"	8' 0"	Grey plastic sandy clay. 4" quartz stringer at 32'0".
33'6" - 39'6"	5' 0"	2' grey plastic sandy clay grading into offwhite friable sandy clay with some iron staining in last 6".
39'6" - 47'6"	5' 2"	Cream-buff hard clay sandstone with patches of iron staining. Last 2' of buff sandstone with sillimanite crystals.
47'6" - 52'6"	4'6"	As above, but grading into grey quartzite with silimanite in last 1'.
52'6" - 60'6"	7' 1"	Grey mica quartzite to buff schistose quartzite
60'6" - 66'6"	5' 6"	Grey sandy schistose quartzite
66'6"	55' 0" % 82.5%	Samples stored Sample from 36' sent for Xray examination

 C.F. 730'6"

BOREHOLE NUMBER 100,000E/99,250N (AGP12)

Commenced 15.00 12/10/68
Finished

DEPTH DRILLED	CORE RECOVERED	REMARKS
0 - 3'	Not cored	Overburden. Brown sand
3' - 4'6"	1' 3"	Brown sandy clay
4'6" - 6'0"	1' 1"	Brown sandy clay
6' - 7'6"	1' 1"	Brown sandy clay
7'6" - 8'6"	1' 0"	Brown sandy clay
8'6" - 10'0"	11"	Brown sandy clay
10'0" - 22'0"	7' 4"	Grey plastic clay with brown stained patches
22'0" - 25'6"	3' 3"	Grey plastic clay but more sandy
25'6" - 31'0"	5' 6"	1' of iron staining, remainder grey plastic clay
31'0" - 37'6"	6' 0"	4' grey plastic clay, 1' seam of green clay, remainder grey plastic clay
37'6" - 42'6"	4' 2"	Grey to green clay with patches of iron staining
42'6" - 46'6"	3' 10"	Brown to cream iron stained sandy clay, some sillimanite evident
48'6" - 53'0"	6' 6"	Brown sandy clay with some grey sandstone with sillimanite
53' - 56'	2' 6"	Grey sillimanite quartzite some quartz veining
50' - 57'6"	8"	Brown quartzite
57'6"	48' 1"	Samples stored
		2" core from 43' sent for Xray examination for sillimanite

% 85

C.F. 816'0"

BOREHOLE NUMBER 100,000E/99,000N (AGP 13)

DEPTH DRILLED	CORE RECOVERED	REMARKS
0 - 3'	Not cored	
3' - 4'6"	1' 0"	Brown sandy clay
4'6" - 6'0"	1' 4"	" " "
6'0" - 7'6"	1' 1"	" " "
7'6" - 8'6"	6"	" " "
8'6" - 9'6"	8"	" " "
9'6" - 11'0"	1' 0"	" " "
11'0" - 15'0"	4' 0"	" " "
15'0" - 25'0"	2' 0"	Grey sandy plastic clay
25'0" - 28'0"	2' 10"	Brown clay
28'0" - 34'0"	5' 5"	Brown sandy clay grading down to 1'6" grey plastic clay
34'0" - 37'6"	3' 6"	Grey sandy plastic clay, last 1' of grey massive quartzite
37'6" - 47'6"	9' 5"	Cream to light buff clay very little sand
47'6" - 52'6"	6' 0"	Buff to cream clay
52'6" - 62'6"	9' 0"	Mostly cream clay with slight green and brown laminations
62'6" - 67'0"	4' 6"	Grey sandy friable clay with slight iron staining
67'0" - 71'6"	4' 0"	Off white sandy clay
71'6" - 77'0"	4' 0"	Off white sandstone stained red, brown and green
77'0" - 81'0"	3' 4"	Schistose sandstone with sillimanite
81'0" - 85'6"	4' 1"	" " " "
85'6"	70' 8"	

Samples for despatch 27'6" - 47'6"
27'6" - 55'0"
55'0" - 63'0"

Rest stored.

C.F. 930'6"

DRILLHOLE 100,000 E / 98,750 N (AGP 14)

FINISHED : pm 16/10/68

DRILL DEPTH	CORE RECOVERY	REMARKS
0 - 4'0"	DRILLED OFF	
4' - 5'6"	1' 0"	BROWN SANDY CLAY
5'6" - 7'0"	1' 2"	RED BROWN SANDY CLAY
7'0" - 8'0"	10"	BROWN SANDY CLAY
8'0" - 9'6"	1' 0"	GREY SANDY CLAY
9'6" - 11'0"	1' 2"	GREY SANDY CLAY, PATCHES OF IRON STAINING
11'0" - 18'6"	5' 1"	1' RED BROWN CLAY, 4'1" GREY SANDY CLAY IRONSTAINED.
18'6" - 25'6"	5' 10"	GREY CLAY, IRONSTAINED BANDS.
25'6" - 32'6"	4' 4"	"
32'6" - 39'6"	5' 10"	"
39'6" - 45'0"	4' 0"	GREY SANDY CLAY.
45'0" - 62'0"	10' 9"	1' GREY OFF WHITE PLASTIC CLAY. 9' CREAM BUFF STICKY CLAY (TALCOSE).
62' - 66'6"	4' 6"	WHITE CREAM STICKY TALCOSE CLAY.
66'6" - 74'6"	4' 4"	2' WHITE STICKY TALCOSE CLAY, 2' SANDY MICACEOUS WHITE CLAY.
74'6" - 78'9"	4'0"	BUFF TO BROWN STAINED WHITE CLAY SANDSTONE
78'9" - 88'6"	9' 9"	BUFF MICACEOUS SANDY CLAY.
88'6" - 91'3"	2' 9"	" " " "
91'3" - 95'6"	4' 3"	" CLAY SANDSTONE
95'6 - 103'	5' 7"	" SCHISTOSE SANDSTONE.
103' - 111'	7' 2"	SOFT GREY CLAYEY SANDSTONE
111' - 115'	4' 0"	" " " "
TOTAL 115'	91' 4"	
	79% RECOVERY	

SAMPLES STORED.

AUSTRAL GEO PROSPECTORS   C.F. 1033'

DRILLHOLE   100,000E / 98 500 N (A.G.P. 15)

STARTED 9.00 am 17/10/68

FINISHED pm 17/10/68

DRILL DEPTH	CORE RECOVERED	REMARKS
0 - 4'6"	NOT CORED	
4'6" - 6'0"	0' 11"	BROWN SAND AND CLAY
6'0" - 7'0"	0' 10"	BROWN STAINED GREY CLAY.
7'0" - 8'6"	1' 2"	"
8'6" - 10'0"	1' 0"	GREY AND BUFF SOFT SANDSTONE
10'0" - 11'0"	10"	BROWN STAINED GREY CLAY SANDSTONE
11'0" - 15'6"	3' 1"	"
15'6" - 20'6"	4' 2"	" LOWER 1' GREY PLASTIC CLAY
20'6" - 22'6"	2' 0"	BROWN STAINED GREY CLAY
22'6" - 24'6"	1' 5"	GREY SANDY CLAY. 2" HARD IRON STAINED BAND AT 22' 8".
24'6" - 27'6"	1' 10"	GREY SANDY CLAY.
22'6" - 36'6"	6' 8"	BROWN STAINED SANDY CLAY.
36'6" - 44'6"	8' 0"	GREY SANDY CLAY.
44'6" - 48'0"	3' 6"	GREY CLAYEY SAND.
48'0" - 52'6"	4' 1"	BUFF SOFT SAND, LOWER PART WHITE CLAY SEVERELY IRONSTAINED.
52'6" - 57'6"	4' 0"	WHITE GREASY CLAY SEVERELY IRONSTAINED.
57'6" - 62'6"	4' 6"	GREASY WHITE AND GREY DENSE CLAY.
62'6" - 68'0"	4' 1"	2' GREY CLAY SAND. REMAINDER GREY MICACEOUS SANDY CLAY WITH PYRITE.
68'0" - 76'0"	4' 7"	GREY SANDY CLAY WITH FINE PYRITE AND COARSE QUARTZ VEIN IN LOWER PART.
76'0" - 84'6"	4' 8"	GREY MICACEOUS CLAY SAND WITH QUARTZ AND PYRITE. LOWER PART COARSE QUARTZ WITH GREY CLAY MATRIX, MICA AND PYRITE.
84'6" - 92'6"	6' 9"	GREY PLASTIC MICACEOUS CLAY.
92'6" - 102'6"	4' 8"	GREY MICACEOUS SANDY CLAY.
TOTAL 102' 6"	77' 3"	

75.5 % RECOVERY

SAMPLES STORED.

C.F. 1126'6"

AUSTRAL GEO PROSPECTORS

DRILL HOLE 100,000 E / 98,250 N (A.G.P. 16)

STARTED A.M. 19/10/68

FINISHED P.M. 19/10/68.

DEPTH DRILLED	CORE RECOVERED	REMARKS
0 - 7'6"	NOT CORED	BROWN SANDY SOIL
7'6" - 15'6"	5' 9"	= BROWN AND GREY SANDY CLAY SUBSOIL
15'6" - 19'0"	2' 3"	= GREY SANDY CLAY WITH IRONSTAINED SILICIFIED SANDSTONE PEBBLES (IRONSTONE).
19'0" - 23'0"	3' 6"	= IRONSTAINED GREY SANDY CLAY.
23'0" - 32'6"	7' 0"	= GREY SANDY CLAY WITH HARD IRONSTONE BANDS THROUGHOUT.
32'6" - 36'6"	3' 4"	= IRONSTAINED GREY SANDY CLAY.
36'6" - 47'0"	8' 6"	6" IRONSTONE BAND, REMAINDER IRONSTAINED = GREY SANDY CLAY (IRONSTAINED).
47'0" - 52'0"	3' 0"	= IRONSTAINED GREY SANDY CLAY. LOWER 2" WHITE CLAYEY SAND AND QUARTZ FRAGMENTS.
52'0" - 62'0"	10' 0"	1' GREY IRON STAINED MICACEOUS CLAYEY SAND 9' HIGHLY MICACEOUS WHITE CLAY WITH QUARTZ FRAGMENTS - SOME IRONSTAINING.
62'0" - 72'6"	10' 6"	7' BUFF SOFT CLAY SAND WITH LARGE MICA FLAKES. LAST 3' BADLY STAINED.
72'6" - 77'	4' 4"	SOFT SANDY MICACEOUS CLAY. BUFF COLOUR
77' - 88'6"	9' 2"	BUFF-GREY SANDY MICACEOUS CLAY.
88'6" - 93'6"	5' 0"	GREY-BLACK MICA RICH ROCK.
TOTAL 93'6"	79' 10"	
	85%	

SAMPLED FOR DESPATCH
54' - 62'
REST STORED.

AUSTRAL GEO PROSPECTORS C.F. 1211' 6"

DRILL HOLE 100000 E / 99750 N (A.G.P. 17)

Started 0700 21/10/68

Finished 1530 21/10/68

DEPTH DRILLED	CORE RECOVERED	REMARKS
0 - 6'	not cored	BROWN SAND.
6' - 9'	2' 3"	BUFF, BROWN SANDY CLAY.
9' - 11'6"	2' 0"	BROWN, RED SANDY CLAY.
11'6" - 13'0"	1' 6"	OFF-WHITE TO GREY CLAY.
13'0" - 20'6"	6' 9"	BUFF SANDY CLAY.
20'6" - 24'6"	3' 0"	CREAM SANDY CLAY.
24'6" - 30'0"	2' 3"	FRIABLE SANDY BUFF CLAY.
30'0" - 37'0"	5' 9"	BROWN BUFF SANDY CLAY.
37'0" - 41'6"	3' 6"	" " " "
41'6" - 45'0"	2' 3"	HARD BUFF MICACEOUS QUARTZITE.
45'0" - 55'0"	5' 6"	BROWN CLAY SANDSTONE
55'0" - 60'0"	3' 7"	BROWN MICACEOUS SAND STONE
60'0" - 64'0"	3' 8"	BROWN FRIABLE SANDY MICACEOUS MATERIAL
64'0" - 71'0"	5' 10"	" " " " "
71'0" - 75'0"	4' 0"	" " " " "
75'0" - 78'0"	3' 0"	BROWN SCHISTOSE QUARTZITE.
78'0" - 85'0"	5' 8"	GREY MICACEOUS QUARTZITE.
TOTAL 85'	66' 6"	
	78.5%	SAMPLES STORED.

AUSTRAL GEO PROSPECTORS C.F. 1293' 6"

DRILLHOLE 99,250 E / 100,250 N (A.G.P. 18)

STARTED 1550 21/10/68
FINISHED 22/10/68

DEPTH DRILLED	CORE RECOVERED	REMARKS
0 - 4'	NOT CORED.	
4' - 9'6"	5' 4"	2' RED BROWN IRON STAINED CLAY, 3' HARD CREAM CLAY SANDSTONE.
9'6" - 14'6"	4' 6"	WHITE STICKY CLAY.
14'6" - 20'6"	5' 8"	CREAM SANDY CLAY.
20'6" - 26'0"	5' 0"	CREAM BUFF CLAY SAND.
26'0" - 32'6"	6' 0"	CREAM BUFF SAND.
32'6" - 36'6"	1' 2"	BUFF SANDY CLAY.
36'6" - 42'6"	4' 0"	BUFF ~~CREAM~~ BROWN STAINED SAND.
42'6" - 45'6"	1' 10"	CREAM BUFF SAND.
45'6" - 47'6"	2' 0"	" " "
47'6" - 58'	8' 2"	" " "
58' - 66'	6' 6"	CREAM SAND.
66' - 70'6"	3' 2"	CREAM WHITE SAND.
70'6" - 77'6"	5' 2"	CREAM BROWN STAINED SAND.
77'6" - 82'	4' 6"	CREAM SAND AT TOP. LOWER: IRONSTAINED GREY QUARTZITE.
TOTAL 82'	67' 0"	
	81%	SAMPLES STORED.

AUSTRAL GEO PROSPECTORS C. F. 1356' 0"

DRILLHOLE 98 250 E / 100,250 N. (A.G.P. 19).

START 23/10/68
FINISH "

DEPTH DRILLED	CORE RECOVERED	REMARKS
0 - 4'	NOT CORED.	RED SANDY CLAY.
4' - 9'	5' 0"	3' WHITE CREAM QUARTZITE, CREAM SAND.
9' - 11'6"	2' 6"	WHITE SAND.
11'6" - 15'	2' 7"	"
15' - 20'	5' 0"	WHITE QUARTZITE SLIGHT IRON STAINING
20' - 24'	3' 9"	2' GREY QUARTZITE, IRONSTAINED. WHITE SAND.
24' - 32'6"	6' 6"	WHITE QUARTZITE, SOME MINERAL BANDING.
32'6" - 43'6"	8' 6"	WHITE SAND + QUARTZITE.
43'6" - 47'6"	3' 6"	WHITE QUARTZITE.
47'6" - 59'6"	10' 11"	WHITE CREAM SANDY QUARTZITE.
59'6" - 62'6"	1' 10"	WHITE QUARTZITE.
TOTAL 62'6"	54' 0"	
	87%	

SAMPLES STORED.

AUSTRAL GEO PROSPECTORS. C.F. 1401' 6"

DRILLHOLE 98790 E / 99750 N (A.G.P. 20).

STARTED 24/10/68
FINISHED "

DEPTH DRILLED	CORE RECOVERED	REMARKS.
0 – 5' 0"	NOT CORED.	
5' – 9'	3' 10"	RED BROWN SANDY CLAY
9' – 16'	3' 6"	IRON STAINED RED BROWN CLAY WITH WHITE SANDY PATCHES.
16' – 22'	3' ~~10~~ 0"	BUFF QUARTZITE.
22' – 31'	8' 6"	BUFF BROWN IRONSTAINED SAND & QUARTZITE.
31' – 35'6"	2' 6"	LIGHT BROWN QUARTZITE
35'6" – 40'6"	4' 9"	"
40'6" – 45'6"	5' 0"	"
TOTAL 45'6"	36' 1"	
	80%	

SAMPLES STORED

AUSTRAL GEO PROSPECTORS C.F. 1481' 6"

DRILL HOLE A.G.P. 21 (CROMER AREA)

DRILL DEPTH	CORE RECOVERED	REMARKS
0 - 6'	NOT CORED	RED LATERITIC SOIL
6' - 11'	5'	GREY HARD MICACEOUS SANDSTONE, HEAVILY LATERITISED.
11' - 16'	4' 6"	2' LATERITISED WHITE MICACEOUS SANDSTONE 2'6" GREY-OFF WHITE MICACEOUS SANDSTONE.
16' - 18'	DRILLED OFF	HARD QUARTZ VEIN.
18' - 26'	7' 0"	BUFF - GREY CLAY VEINED SANDSTONES, HEAVILY IRON STAINED.
26' - 32'6"	5' 10"	WHITE, LATERITISED MICACEOUS SANDSTONES.
32'6" - 42'6"	5' 9"	AS ABOVE WITH MINOR WHITE CLAY VEIN
42'6" - 47'6"	2' 7"	BROWN GREY MICACEOUS SANDSTONE
47'6" - 60'6"	12' 6"	AS ABOVE
60'6" - 69'6"	6' 10"	" " BECOMING HARDER.
69'6" - 74'0"	4' 3"	SANDY GREY MICA QUARTZITE
74'0" - 80'0"	5' 0"	" " " "
TOTAL 80'0"	67' 3"	
	84 %	SAMPLE STORED.

AUSTRAL GEO PROSPECTORS C. F. 1543' 0"

DRILLHOLE A. G. P. 22 (CROMER AREA)

START 0730 SUNDAY
FINISHED 1300 "

DRILL DEPTH	CORE RECOVERED	REMARKS
0 - 4'	NOT CORED	
4 - 8'6"	4' 4"	WHITE, BUFF & GREY LAMINATED MICA SANDSTONE
8'6" - 14'6"	5' 3"	WHITE & VARIABLY STAINED MICA SANDSTONE
14'6" - 24'0"	7' 10"	VARIABLY STAINED MICA SANDSTONE
24' - 32'6"	7' 9"	VARIABLY STAINED GREY MICA SANDSTONE
32'6" - 36'6"	4' 0"	AS ABOVE WITH THIN 1/8" CLAY VEIN.
36'6" - 39'6"	3' 0"	GREY MICA SANDSTONE WITH THIN CLAY VEINING.
39'6" - 46'6"	8' 3"	AS ABOVE
46'6" - 51'0"	5' 1"	SANDY MICA QUARTZITES BECOMING MASSIVE
51'0" - 61'6"	9' 0"	IN LOWER PART
TOTAL 61'6"	58' 6"	
	95%	SAMPLES STORED

AUSTRAL GEO PROSPECTORS C.F. 1606'

DRILLHOLE A.C.P. 23

DRILL DEPTH	CORE RECOVERED	REMARKS
0 - 4'6"	NOT CORED	RED LATERITE SOIL
4'6" - 9'6"	4' 8"	BUFF SANDY CLAY
9'6" - 17'0"	5' 3"	3' WHITE MICACEOUS CLAY. REMAINDER GREY MICACEOUS SANDSTONE.
17'0" - 26'0"	4' 9"	AS ABOVE.
26'0" - 34'6"	8' 6"	" "
34'6" - 40'	6' 0"	" " WITH 1' CREAM CLAY VEIN AT 36'.
40' - 50'6"	10' 0"	GREY MICACEOUS SANDSTONE BECOMING BLACK AND MASSIVE IN LOWER PART WITH THIN CLAY VEINING
50'6" - 61'0"	8' 3"	AS ABOVE
61'0" - 63'0"	1' 4"	" "
TOTAL 63'	53' 3"	
	84%	SAMPLES STORED

AUSTRAL GEO PROSPECTORS C.F. 1654'

DRILLHOLE A.G.P. 24 (CROMER AREA).

DRILL DEPTH	CORE RECOVERED	REMARKS
0' - 5'6"	not cored	
5'6" - 10'6"	5' 0"	BUFF BROWN BLEACHED & IRONSTAINED MICA SANDSTONE.
10'6" - 15'0"	4' 0"	"
15'0" - 23'0"	5' 4"	"
23'0" - 35'0"	8' 6"	"
35'0" - 45'0"	9' 7"	BECOMING HARDER AND ENDING
45'0" - 48'0"	2' 8"	IN MICA QUARTZITE
TOTAL 48'	40' 7"	
	85 %	

AUSTRAL GEO PROSPECTORS C.F. 1707'

DRILLHOLE A.G.P. 25 (CROMER AREA)

DRILL DEPTH	CORE RECOVERED	REMARKS
0' - 5'	NOT CORED	
5' - 10'	4' 0"	2' RED LATERITISED SANDY CLAY 2' BUFF, WHITE SANDSTONE, SOME MINERAL BANDING.
10' - 13'6"	3' 4"	CREAM, WHITE CLAY SANDSTONE, IRONSTAINED.
13'6" - 16'6"	2' 11"	WHITE CLAY SANDSTONE, IRONSTAINED.
16'6" - 19'	2' 1"	WHITE, BUFF SANDY CLAY.
19' - 22'0"	2' 9"	WHITE SANDY CLAY, IRONSTAINED.
22' - 30'	3' 7"	RED SANDY CLAY.
30' - 31'6"	1' 6"	WHITE, FRIABLE, TALCOSE SANDY CLAY.
31'6" - 37'6"	4' 5"	RED/CREAM IRONSTAINED TALCOSE CLAY.
37'6" - 53'	9' 11"	RED TALCOSE CLAY
TOTAL 53'	39' 6"	
	74.5 %	

AUSTRAL GEO PROSPECTORS C.F. 1775'

DRILL HOLE A.C.P. 26 (99500 E / 100750 N)

DRILL DEPTH	CORE RECOVERED	REMARKS
0' - 5'	NOT CORED	
5' - 7'6"	2' 6"	IRON STAINED CREAM CLAY SANDSTONE
7'6" - 12'	4' 5"	HARD, OFFWHITE CLAY SANDSTONE.
12' - 22'	8' 8"	"
22' - 29'	6' 8"	OFF WHITE CLAY.
29' - 34'6"	5' 4"	OFF WHITE CLAY SANDSTONE
34'6" - 43'0"	4' 9"	WHITE SANDY CLAY
43' - 59'	7' 10"	WHITE, BUFF SANDY CLAY.
59' - 64'	DRILLED OFF	HARD QUARTZITE.
64' - 68'	3' 0"	"
TOTAL 68'	53' 2"	
	78%	

AUSTRAL GEO PROSPECTORS C.F. 1859' 6"

DRILL HOLE A.C.P. 27 (99750 E / 100720 N)

DRILL DEPTH	CORE RECOVERED	REMARKS
0' - 5'	NOT CORED	
5' - 10'	5' 0"	HARD WHITE SANDSTONE
10' - 14'6"	3' 7"	CREAM CLAY SANDSTONE
14'6" - 23'	8' 6"	CREAM CLAY SANDSTONE, IRONSTAINING.
23' - 32'	7' 0"	BUFF, WHITE CLAY SANDSTONE
32' - 36'	3' 9"	MEDIUM HARD, BROWN MICACEOUS SANDSTONE.
36' - 47'6"	11' 3"	BROWN MICACEOUS SANDSTONE (SCHIST)
47'6" - 51'	2' 7"	"
51' - 59'6"	7' 4"	GREY MICA, QUARTZ SCHIST
59'6" - 77'6"	18' 0"	"
77'6" - 84'6"	6' 4"	"
TOTAL 84' 6"	78' 4"	
	93%	

AUSTRAL GEO PROSPECTORS C.F. 1921' 6"

DRILLHOLE A.G.P. 28 (99750 E/100,050 N)

FINISHED 3/11/68

DRILL DEPTH	CORE RECOVERED	REMARKS
0' - 5'	NOT CORED	
5' - 12'	6' 0"	3' GREY, BUFF PLASTIC CLAY
		3' SANDY CLAY, IRONSTAINED.
12' - 24'	8' 5"	GREY, BUFF SANDY CLAY, IRONSTAINED.
24' - 30'6"	5' 0"	BROWN & WHITE SANDS.
30'6" - 42'6"	NOT CORED	BROWN QUARTZITE
42'6" - 46'	2' 10"	BROWN QUARTZITE WITH
		1' SEAM OF BROWN, CREAM CLAY.
46' - 62'	13' 0"	GREY, IRONSTAINED QUARTZITE.
TOTAL 62'	52' 3"	
	84%	

AUSTRAL GEO PROSPECTORS SMALL RIG (FAILING 200)

DRILL HOLE 99 095 E / 160500 N (S.G.P. 1)

STARTED 1·00 pm 17/10/68
FINISHED 10·00 am 18/10/68.

DEPTH DRILLED.	CORE RECOVERED	REMARKS.
0 - 3'5"	NOT CORED.	
3'5" - 4'5"	5"	IRONSTAINED FINE WHITE SANDSTONE.
4'5" - 5'5"	9"	SEVERE RED STAINED WHITE SANDSTONE.
5'5" - 6'5"	6"	HARD WHITE QUARTZITE, FINE BLACK SPECKING.
6'5" - 7'5"	7"	SILLIMANITE QUARTZITE, LOWER PART SOFT SAND IRONSTAINED.
7'5" - 8'5"	8"	HARD FINE GRAINED WHITE QUARTZITE.
8'5" - 9'5"	4"	FINE GRAINED SANDSTONE WITH HARD 1/4" GREY GREEN BAND.
9'5" - 10'5"	10"	FINE WHITE SANDSTONE WITH GREEN STAINING IN FRACTURES.
10'5" - 20'8"	DRILLED OFF	VERY HARD QUARTZITE - CHIP SAMPLES, WITH BUFF SANDY CLAY.
20'8" - 27'4"	5' 0"	VERY HARD WHITE QUARTZITE, IRON STAINING IN FRACTURES.
TOTAL 27'4"	19' 9"	
	72·5%	

SAMPLES STORED.

DRILLHOLE 98625 E / 100,500 N (S.C.P. 2)

STARTED 12.00 pm 18/10/68

FINISHED 12.00 pm 19/10/68.

DEPTH DRILLED	CORE RECOVERED	REMARKS.
0 - 3'6"	NOT CORED	RED LATERITE SOIL
3'6" - 4'6"	5"	WEATHERED MICACEOUS BROWN SAND.
4'6" - 5'6"	7"	MICA, QUARTZ SAND.
5'6" - 6'6"	1' 0"	MICA, QUARTZ SCHIST (WEATHERED)
6'6" - 7'6"	1' 0"	" " " "
7'6" - 8'6"	10"	" " " "
8'6" - 9'6"	6"	" " " "
9'6" - 18'6"	2' 10"	" " " "
18'6" - 24'0"	1' 6"	" " " "
24'0" - 26'0"	9"	" " " "
26'6" - 30'0"	3' 0"	HARD MICACEOUS QUARTZ SCHIST.
30'0" - 35'0"	4' 6"	" " " "
35'0" - 40'0"	5' 0"	" " " "
40'0" - 43'6"	2' 10"	" " " "
TOTAL 43'6"	28' 3"	
	65%	SAMPLES STORED.

CUMULATIVE FOOTAGE 151' 10"

AUSTRAL GEO PROSPECTORS SMALL RIG (FAILING 200)

DRILL HOLE 98170 E/ 101000 N (S.G.P. 3).

DEPTH DRILLED	CORE RECOVERED	REMARKS
0 - 2'	not cored	
2' - 4'7"	1' 0"	red brown clay subsoil soffish white sandstone
4'7" - 5'7"	1' 0"	hard white sand stone with mica
5'7" - 6'7"	1' 0"	"
6'7" - 8'7"	1' 6"	"
8'7" - 9'7"	10"	"
9'7" - 11'7"	1' 0"	"
11'7" - 14'7"	2' 3"	"
14'7" - 17'7"	1' 3"	"
17'7" - 18'7"	8"	"
18'7" - 18'11"	4"	"
18'11 - 19'11	6"	"
19'11" - 22'1"	1' 8"	"
22'1" - 23'1"	6"	"
23'1" - 24'3"	1' 0"	"
24'3" - 29'3"	3' 0"	"
29'3" - 30'8"	1' 3"	"
30'8" - 40'8"	7' 10"	"
40'8" - 49'8"	8' 7"	"
49'8" - 58'3"	7' 6"	"
58'3" - 60'10"	1' 0"	"
60'10" - 62'2"	0' 8"	quart vein
62'2" - 63'1"	6"	quartz fragments + yellowstained sand stone.
63'1" - 68'3"	10"	"
68'3" - 71'	1' 8"	hard white quartzite
71' - 76'	2' 9"	"
76' - 81'	4' 10"	"
TOTAL 81'	57' 11"	

72%

SAMPLES STORED.

AUSTRAL GEO PROSPECTORS SMALL RIG. C.F. 192' 5"

DRILL HOLE 98 150 E / 100 900 N (S.G.P. 4).

STARTED 16:30 22/10/68

FINISHED 16·30 23/10/68

DRILL DEPTH	CORE RECOVERED	REMARKS
0 - 2'6"	NOT CORED	LIGHT BROWN TOPSOIL + IRONSTAINED CLAY.
2'6" - 3'6"	9"	WHITE SAND, BROWN STAINED.
3'6" - 5'3"	10"	WHITE SAND.
5'3" - 6'3"	1' 0"	"
6'3" - 7'	9"	"
7' - 8'	1' 0"	"
8' - 9'	10"	"
9' - 10'	1' 0"	"
10' - 12'	1' 2"	WHITE TALLOSE SAND CLAY.
12' - 13'	8"	WHITE SANDSTONE.
13' - 14'	6"	"
14' - 15'	4"	"
15' - 16'	9"	"
16' - 17'	1' 0"	"
17' - 18'	1' 0"	"
18' - 19'	1' 0"	WHITE SANDSTONE, BUFF STAINING.
19' - 20'	10"	WHITE SANDSTONE.
20' - 21'	9"	"
21' - 22'	8"	"
22' - 24'	1' 7"	"
24' - 27'7"	3' 0"	WHITE SANDSTONE, IRONSTAINED CLAY BAND AT 27'.
27'7" - 30'7"	2' 6"	WHITE MASSIVE QUARTZITE
30'7" - 40'7"	7' 9"	" " "
TOTAL 40'7"	31' 5"	
	77·5%	

5' - 15'

~~3'6" - 27'7"~~ SAMPLED FOR DESPATCH.

AUSTRAL GEO PROSPECTORS SMALL RIG. C.F. 253'

DRILLHOLE 98275 E / 100500 N (S.G.P. 5)

START 16·30 23/10/68

FINISH 11·00 24/10/68.

DEPTH DRILLED	CORE RECOVERED	REMARKS.
0 - 2'	NOT CORED	
2' - 3'	7"	LIGHT BROWN SAND CLAY.
3' - 4'	1' 0"	" " " "
4' - 5'	1' 0"	BROWN MICACEOUS SAND. CLAY.
5' - 6'	1' 0"	"
6' - 7'	1' 0"	"
7' - 8'	1' 0"	"
8' - 10'	1' 9"	"
10' - 12'	2' 0"	"
12' - 20'9"	2' 8"	"
20'9" - 30'1"	8' 0"	MASSIVE BROWN MICACEOUS QUARTZITE.
30'1" - 37'8"	7' 6"	"
37'8" - 39'8"	2' 0"	"
39'8" - 48'7"	5' 7"	"
48'7" - 58'7"	10' 0"	"
58'7" - 60'7"	1' 10"	"
TOTAL 60'7"	46' 11"	
	77%	SAMPLES STORED.

AUSTRAL GEO PROSPECTORS SMALL RIG C.F. 304' 4"

DRILLHOLE 98000 E / 99750 N (S.G.P. 6)

DRILL DEPTH	CORE RECOVERED	REMARKS
0 - 2' 6"	NOT CORED	RED BROWN CLAY SOIL
2'6" - 4'6"	2' 0"	WHITE CLAYEY SAND
4'6" - 6'6"	1' 11"	WHITE CLAYEY SANDSTONE
6'6" - 8'6"	2' 0"	HARD WHITE MICACEOUS SANDSTONE WITH MINOR CLAY VEIN.
8'6" - 10'6"	2' 0"	SOFT WHITE CLAYEY SANDSTONE
10'6" - 18'6"	6' 0"	WHITE TO GREY CLAY SANDSTONE.
18'6" - 20'6"	1' 9"	WHITE SANDSTONE, BUFF COLOURED IN LOWER PART
20'6" - 25'9"	3' 10"	WHITE SANDSTONE
25'9" - 29'3"	3' 0"	BUFF & WHITE SANDSTONE
29'3" - 32'10"	3' 5"	" " "
32'10" - 36'11"	3' 10"	WHITE SANDSTONE WITH THIN BLACK MINERAL BANDS
36'11" - 40'10"	3' 3"	" " " " " "
40'10" - 46'8"	5' 8"	" " " " " "
46'8" - 51'4"	4' 2"	HARD & MASSIVE WHITE QUARTZITE
TOTAL 51'4"	45' 4"	SAMPLED FOR DESPATCH 4'6" - 18'8"
	88.5%	

AUSTRAL GEO PROSPECTORS SMALL RIG C.F. 435' 7"

DRILL HOLE S.G.P. 7 (99200 E / 101,086 N)

DRILL DEPTH	CORE RECOVERED	REMARKS
0 - 1'5"	NOT CORED.	
1'5" - 3'5"	1' 6"	BUFF FRIABLE CLAY SANDSTONE
3'5" - 5'5"	1' 9"	
5'5" - 7'5"	1' 3"	WHITE CLAY SANDSTONE
7'5" - 9'5"	2' 0"	
9'5" - 11'5"	2' 0"	
11'5" - 20'6"	6' 0"	1' WHITE CLAY SANDSTONE, REST BUFF SANDSTONE
20'6" - 30'6"	3' 0"	WHITE CLAY SANDSTONE.
30'6" - 39'6"	2' 1"	
39'6" - 41'6"	2' 2"	WHITE CLAY SANDSTONE WITH LIGHT BROWN IRONSTAINED BANDS.
41'6" - 43'6"	1' 2"	"
43'6" - 44'9"	1' 2"	"
44'9" - 46'9"	2' 0"	"
46'9" - 48'4"	1' 7"	WHITE CLAY SANDSTONE.
48'4" - 50'4"	2' 2"	WHITE CLAY SANDSTONE, IRONSTAINED BANDS.
50'4" - 60'5"	4' 9"	"
60'5" - 62'5"	1' 10"	SOFT WHITE CLAY SANDSTONE, IRONSTAINED BANDS.
62'5" - 64'5"	2' 3"	WHITE FRIABLE CLAY SANDSTONE.
64'5" - 66'5"	1' 6"	WHITE CLAY SANDSTONE, BUFF STAINING.
66'5" - 68'5"	1' 9"	"
68'5" - 70'6"	1' 10"	"
70'6" - 72'7"	1' 7"	"
72'7" - 74'7"	1' 6"	"
74'7" - 76'7"	1' 11"	"
76'7" - 86'7"	3' 8"	"
86'7" - 90'7"	3' 2"	BUFF, WHITE CLAY SANDSTONE
90'7" - 93'10"	1' 3"	"
93'10" - 100'9"	4' 7"	"
100'9" - 105'10"	4' 6"	"
105'10" - 110'11"	3' 0"	"
110'11" - 116'0"	4' 0"	"
116' - 121'	4' 10"	"
121' - 129'	6' 6"	OFF WHITE CLAY SANDSTONE, SLIGHT IRONSTAINING.
129' - 131'3"	2' 2"	OFF WHITE CLAY SANDSTONE.
TOTAL 131'3"	87' 10"	
	67 %	

AUSTRAL GEO PROSPECTORS SMALL RIG C.F. 472' 3"

DRILLHOLE S.G.P. 8+9 (99 060 E / 101 050 N)

DRILL DEPTH	CORE RECOVERED	REMARKS
0' - 1'6"	NOT CORED	
1'6" - 2'0"	6"	RED CLAY.
2' - 4'	1' 0"	"
4' - 6'	2' 0"	BUFF SANDY CLAY.
6' - 8'	1' 1"	YELLOW SAND.
8' - 10'	2' 0"	"
10' - 12'	2' 0"	YELLOW, BUFF SAND.
12' - 14'	2' 0"	CREAM SAND.
14' - 16'	2' 0"	BUFF SAND.
16' - 18'	1' 2"	CREAM SAND.
18' - 20'	2' 0"	OFFWHITE, BUFF SAND.
20' - 22'	2' 0"	YELLOW SAND, THIN QUARTZ SEAM
22' - 27'	1' 0"	BUFF SAND.
27' - 30'8"	1' 8"	BUFF SANDSTONE WITH LAYERS OF NEEDLE CRYSTALS, BECOMING MICACEOUS QUARTZITE.
30'8" - 34'11"	4' 3"	BROWN MICACEOUS QUARTZITE, NEEDLE CRYSTALS.
34'11" - 36'8"	1' 9"	MASSIVE GREY QUARTZITE
TOTAL 36'8"	27' 11"	
	76%	

AUSTRAL GEO PROSPECTORS SMALL RIG C.F. 499' 0"

DRILLHOLE S.G.P. 9 (98780 E / 101 050 N)

DRILL DEPTH	CORE RECOVERED	REMARKS
0' - 1'	NOT CORED.	
1' - 2'	1' 0"	GREY SAND & RED BROWN CLAY.
2' - 4'	1' 9"	RED BROWN CLAY UNDERLAIN BY HARD WHITE CLAY SANDSTONE.
4' - 6'	2' 0"	HARD, WHITE & CREAM CLAY SANDSTONE.
6' - 8'	1' 9"	OFF WHITE & BUFF SANDY CLAY.
8' - 10'	2' 0"	WHITE SANDSTONE.
10' - 15'	5' 0"	WHITE SANDSTONE
15' - 18'8"	2' 9"	OFF WHITE SANDSTONE.
18'8" - 23'3"	3' 0"	"
23'3" - 24'9"	1' 6"	BUFF-GREY CLAY.
24'9" - 26'9"	1' 7"	OFF WHITE QUARTZITE.
TOTAL 26'9"	23' 4"	87%

AUSTRAL GEO PROSPECTORS SMALL RIG C.F. 557' 10"

DRILLHOLE S.G.P. 10 (99200 E / 101400 N)

FINISHED 4/11/68

DRILL DEPTH	CORE RECOVERED	REMARKS
0' - 1'	NOT CORED	
1' - 2'	1' 0"	RED SAND & CLAY.
2' - 4'	1' 0"	BUFF SAND.
4' - 6'	1' 5"	CREAM CLAY SAND.
6' - 8'	2' 0"	CREAM SAND.
8' - 10'	2' 0"	CREAM, OFF WHITE SAND
10' - 20'6"	4' 6"	OFFWHITE, BUFF SAND & SANDSTONE.
20'6" - 24'6"	1' 10"	BUFF SANDSTONE.
24'6" - 40'10"	8' 4"	"
40'10" - 50'10"	2' 9"	BUFF, BROWN MICACEOUS SAND.
50'10" - 54'10"	1' 0"	"
54'10" - 58'10"	6"	"
TOTAL 58' 10"	27' 4"	
	46.5%	

FINISH

TOTAL FOOTAGE 557' 10"

PRICE ANDERSON.

C.F. 42'6"

BOREHOLE NUMBER 98,875G/100,500N

Spudded in 2.30 p.m. 27th September 1968.

DEPTH DRILLED	CORE RECOVERED	REMARKS
0 - 2'6"	Not cored	Brown overburden with quartz fragments.
2'6" - 5'0"	0'7"	Medium hard buff sandstone
5'0" - 7'0"	1'5"	Firm buff sandstone becoming soft and friable in lower part.
7'0" - 15'0"	1'11"	Buff coloured soft sandstone with some plasticity.
15'0" - 18'6"	3'6"	Upper part: Buff friable sandstone. Middle part: Buff-hard sandstone with thin white bands and black flecking.
18'6" - 23'6"	1'11"	Buff friable sandstone in upper part. Middle and lower part - buff and pale green clayey sandstone. Some iron spotting.
23'6" - 27'0"	1'9"	Green micaceous sandstone - hard off white sandstone green veining.
27'0" - 29'6"	2"	Hard off white sandstone with black flecking and green veining.
29'6" - 33'0"	2'3"	Green and grey sandstone with green and brown veining, some clay patches.
3.30 p.m. 28/9/68	30/9/68 - 2/10/68.	
33'0" - 34'6"	4"	Massive off white quartzite.
34'6" - 39'6"	2"	Massive off white quartzite.
39'6" - 41'0"	1'6"	Massive off white quartzite.
41'0" - 42'6"	1'0"	Massive off white quartzite.
42'6"	19'0"	P.C.W. requested drill be moved to new site.

Recovery 44.5%

BOREHOLE NUMBER 100,000E/100859N (P.A.2)

Commenced 14.00 hours 3/10/68

DEPTH DRILLED	CORE RECOVERED	REMARKS
0' - 2'6"	Nor cored	Overburden
2'6" - 5'0"	1'3"	4" yellow brown sand and clay - remainder white grey red and brown clay.
5'0" - 6'0"	10"	Grey and brown clay. Lower part hard sandstone with black flecking.
6'0" - 11'0"	3'9"	1' hard clay sandstone. Remainder soft clay sandstone with patches of light brown. Clay content high in bottom and middle parts.
4/10/68		
11'0" - 13'3"	2'2"	Medium hard clayey sandstone Top 5" bad iron staining.
13'3" - 17'0"	2'5"	Medium hard clayey sandstone. Lower part soft.
17'0" - 22'0"	3'4"	Medium soft clayey sandstone with white clay vening.
22'0" - 25'0"	3'0"	As above with abundant clay veins.
25'0" - 29'6"	4'1"	Clayey sandstone iron stained (yellow orange).
29'6" - 32'0"	1'5"	As above. Less iron staining.
32'0" - 35'0"	8"	Medium soft clayey sandstone with iron staining.
5/10/68		
35'0" - 39'0"	3'0"	Hard green quartzite with thin brown clay bands.
39'0" - 41'0"	1'8"	Massive hard white quartzite green and red staining.
41'0" - 42'0"	1'0"	Hard massive quartzite becoming iron stained and sandy in lower part.
7/10/68		
42'0" - 46'0"	1'6"	Grey green quartzite iron stained.
		Completed 11.30 7/10/68
46'0"	32'7" Recovery 71%	Sampled 11'0" - 25'

BOREHOLE NUMBER 100,625E/100,500N (P.A.3)

Commenced 13.00 7/10/68

DEPTH DRILLED	CORE RECOVERED	REMARKS
0 - 5'6"	Nor cored	Red lateritic overburden.
5'6" - 9'6"	4'0"	Hard clay sandstone with brown mottling.
9'6" - 13'6"	3'10"	Hard grey sandstone with clay veining and some iron staining.
13'6" - 17'	3'5"	Medium hard clayey sandstone with clay veining. Cream coloured with green colouration in central part.
17' - 19'6"	2'2"	White friable dry sandstone with 1" quartz vein.
19'6" - 22'0"	2'2"	Soft white clay sandstone, slight iron staining last 1".
22'0" - 24'6"	2'6"	2' badly ironstained clay, last 6" white dry sandstone with dark mineral banding.
24'6" - 29'6"	4'4"	Variably stained dry sandstone with clay veining, friable.
29'6" - 34'6"	2'5"	Dark brown clayey sandstone.
34'6" - 37'6"	2'0"	Soft brown clay.
37'6" - 41'	3'6"	Variable stained friable sandstone with quartz.veining.
41' - 44'6"	2'9"	1' white dry sandstone. Remainder badly stained.
44'6" - 47'6"	3'0"	Brown - buff sandy clays.
47'6" - 50'6"	2'0"	Soft brown sand clay.
50'6" - 59'6"	3'6"	Soft brown and greenish white clays.
59'6" - 62'0"	1'3"	Cream brown sandy clays.
62'0" - 63'0"	1'0"	Hard sandy quartzite.
		Finished 12.00 9/10/68
63'0"	49'6"	

Recovery 79%

?")-20- C.F. 192'6"

BOREHOLE NO. 99250E/101,000N. (P.A.4)

Commenced 15.30 9/10/68

DEPTH DRILLED	CORE RECOVERED	REMARKS
0 - 3'3"	Drilled off	
3'3" - 5'6"	2'8"	Hard buff silicified sandstone with white felspar veining.
5'6" - 10'6"	4'8"	
10'6" - 15'6"	6'2"	
15'6" - 20'6"	2'5"	White and brown mottled clay sandstone buff mottled white clay sandstone.
20'6" - 24'6"	2'7"	As above.
24'6" - 27'0"	2'10"	As above.
27'0" - 28'0"	1'0"	As above.
28'0" - 29'6"	1'4"	As above.
29'6" - 32'6"	1'4"	White sandy clays some iron staining.
32'6" - 35'0"	2'0"	Brown stained white clay sand matrix.
35'0" - 37'0"	1'5"	Stained brown clay sand.
37'0" - 41'0"	1'0"	As above.
41'0"	23'8"	Hole stopped on 13.00 hrs. 10/10/68 due to poor recovery in clay bearing strata. Sample stored.

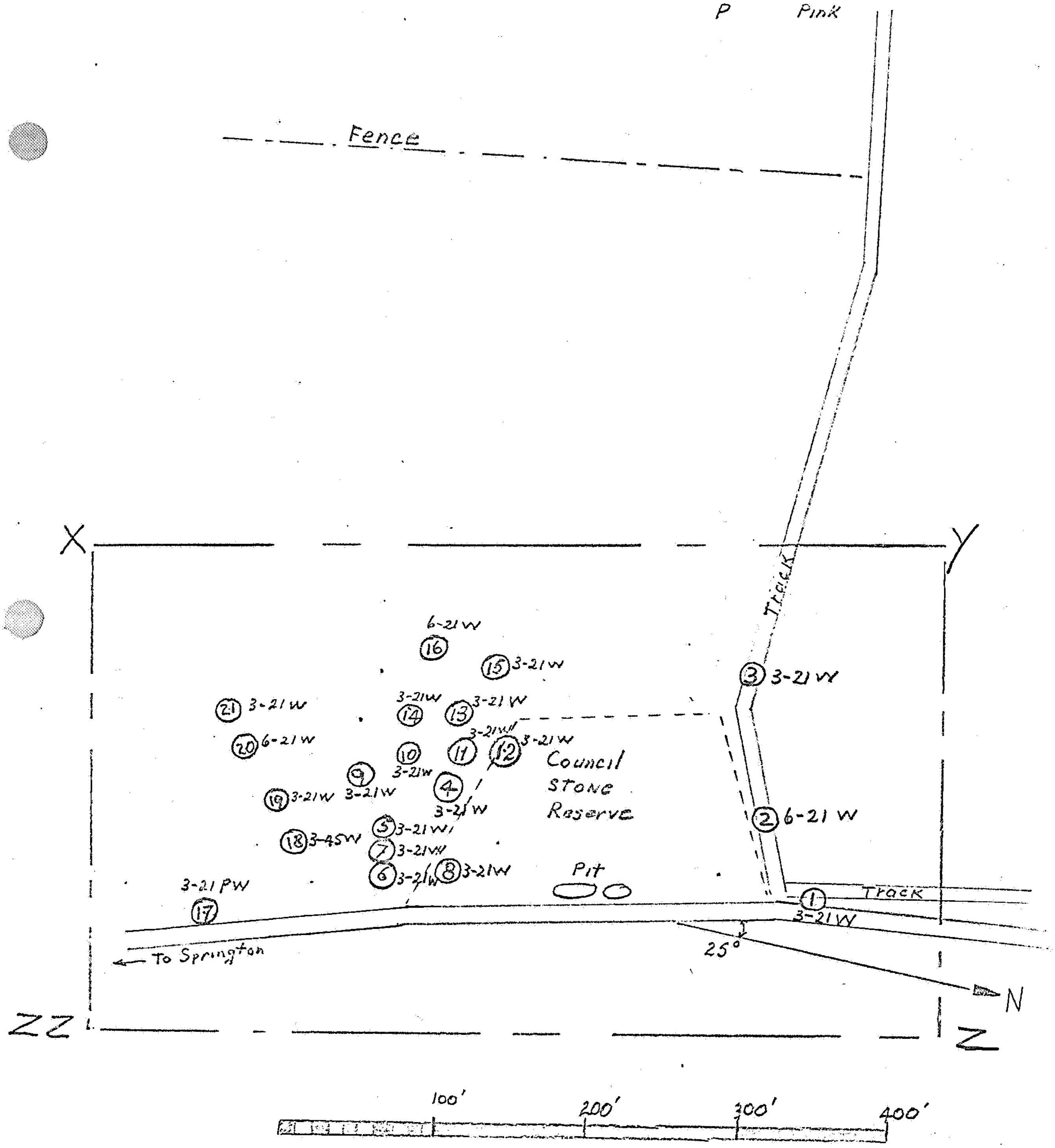
Recovery 58%

Field Map of Mineral Lease MR 1983 Showing Bore Holes

Proline Auger

① (Prefixed By "H") Proline Auger Drill
3-21W Holes stopped at 21ft Unbottomme

3-21 Depth of Clay
W White colour of Clay.
P Pink



Scale - 300ft PER 1 inch

MAP 1

MOUNT CRAWFORD KAOLIN DEPOSIT

Original "Holes" Drilled with Proline Auger Drill

See Map 1

HOLE NUMBERS PREFIXED BY "H"

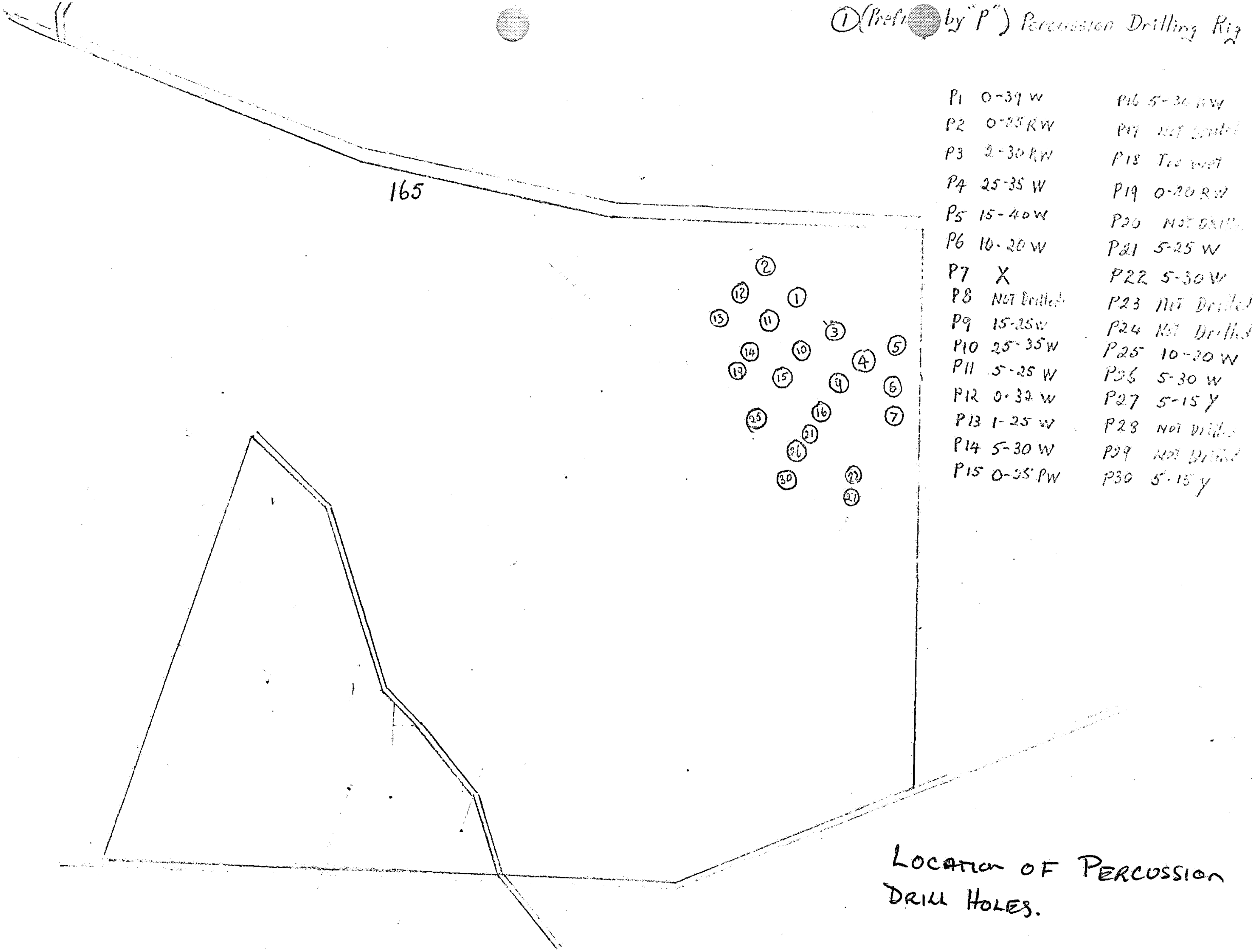
H.1			H.2		
	0 - 3'	Overburden		0 - 6'	Overburden
	3 - 21'	White Clay		6 - 18'	White Clay
		Thin Quartz at 15'		18 - 21'	Cream Clay
H.3			H.4		
	0 - 3'	Overburden		0 - 3'	Overburden
	3 - 21'	Cream Clay		3 - 15'	Cream Clay
				15 - 21'	Yellow Bentdnite like material
H.5			H.6		
	0 - 3'	Overburden		0 - 3'	Overburden
	3 - 18'	Cream Clay		3 - 21'	White Clay
	18 - 21'	White Clay			
H.7			H.8		
	0 - 3'	Overburden		0 - 3'	Overburden
	3 - 21'	White Clay		3 - 21'	White Clay
H.9			H.10		
	0 - 3'	Overburden		0 - 3'	Overburden
	3 - 12'	White Clay		3 - 9'	White Clay
	12 - 21'	Cream Clay		9 - 15'	Cream Clay
				15 - 18'	White Clay
				18 - 21'	Cream Clay
H.11			H.12		
	0 - 3'	Overburden		0 - 3'	Overburden
	3 - 21'	White Clay		3 - 21'	Cream Clay
H.13			H.14		
	0 - 3'	Overburden		0 - 3'	Overburden
	3 - 12'	White Clay		3 - 21'	White Clay
	12 - 21'	Cream Clay			
H.15			H.16		
	0 - 3'	Overburden		0 - 6'	Overburden
	3 - 21'	Cream Clay		6 - 21'	White Clay
H.17			H.18		
	0 - 3'	Overburden		0 - 3'	Overburden
	3 - 6'	Pink) High %		3 - 45'	White Clay
	6 - 15'	Cream) of			
	15 - 21'	Cream) silica			

MOUNT CRAWFORD KAOLIN DEPOSIT

Original "Holes" Drilled with Proline Auger Drill

HOLE NUMBERS PREFIXED BY "H"

H.19 0 - 3' Overburden 3 - 21' White Clay	H.20 0 - 6' Overburden 6 - 18' White Clay 18 - 21' Cream Clay
H.21 0 - 3' Overburden 3 - 18' White (12 - 15 Mica or Talc) 18 - 21' Cream Clay	



LOCATION OF PERCUSSION DRILL HOLES.

MAP 2

MOUNT CRAWFORD KAOLIN DEPOSIT

Scout Holes Drilled by Percussion Drill

See Map 2

NUMBERS PREFIXED BY "P"

P.1 0 - 30' White Kaolinised Sandstone 30 - 35' Buff Clay with stained Sand 35 - 39' Buff Kaolin 39 - 40' Red Sand	**P.2** 0 - 5' Red Kaolin 5 - 10' Buff Clay 10 - 15' Kaolin & Sand 15 - 25' Kaolin & Sand 25 - 30' Pure Silica.
P.3 0 - 2' Hard Sandstone Cap 2 - 3' Iron Stained Clay 3 - 30' Buff Kaolin	**P.4** 0 - 5' Overburden 5 - 15' Buff Sand, some Kaolin 15 - 20' Pink Sandy material. Trace of Kaolin 20 - 25' Buff Sand, Some Kaolin 25 - 30' White Kaolin 30 - 35' Buff Kaolin
P.5 0 - 5' Brown Sandy Soil, Trace of Kaolin 5 - 10' Buff Sand, Some Kaolin 10 - 15' Buff Sand 15 - 40' White Kaolin	**P.6** 0 - 10' Brown Clay Soil, Trace of Kaolin 10 - 15' White Kaolinised Sandstone 15 - 20' Buff Kaolinised Sandstone 20 - 40' Sandstone, Little Kaolin
P.7 0 - 5' Brown Clay 5 - 15' Buff Sandstone, very little Kaolin 15 - 25' White Sandstone, very little Kaolin 25 - 40' Sandstone	**P.9** 0 - 5' Sandy Soil 5 - 10' Stained Sand 10 - 15' Kaolin with Silica 15 - 20' White Kaolin 20 - 25' White Kaolin
P.10 0 - 5' Overburden 5 - 10' Buff Sandy Kaolin 10 - 15' Sandy, Quartz Stringers 15 - 20' Iron stained Sandstone 20 - 25' Iron stained Sandstone 25 - 35' Buff Kaolin	**P.11** 0 - 5' Brown Clay 5 - 10' Buff Kaolin 10 - 15' Sand Seams between Kaolin Bands. 15 - 25' Buff Kaolin
P.12 0 - 32' White Kaolinised Material. High % Kaolin	**P.13** 0 - 1' Overburden 1 - 5' Buff Kaolin 5 - 10' Buff Kaolin 10 - 20' Band of Stained Kaolinised Sandstone 20 - 25' White Kaolin

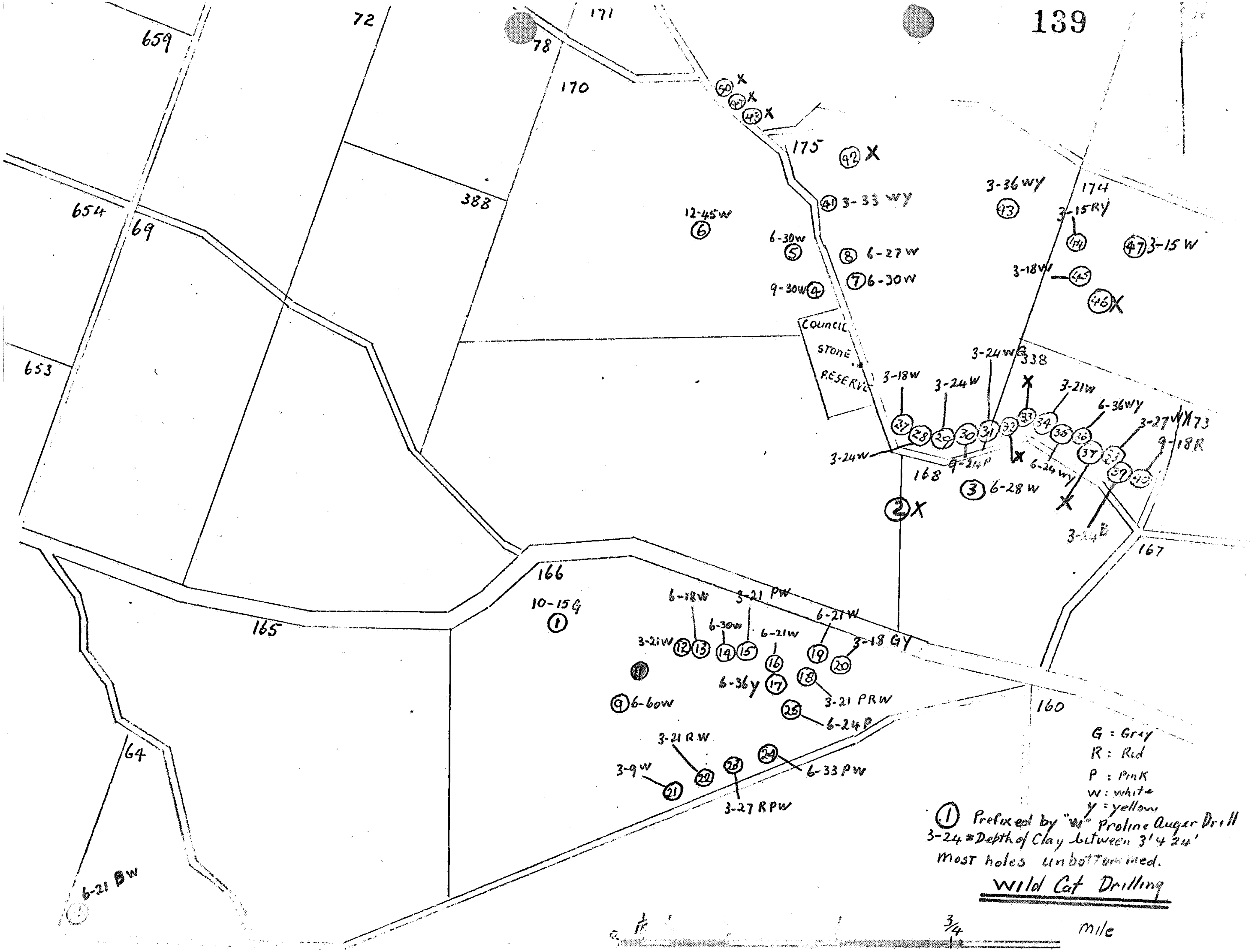
MOUNT CRAWFORD KAOLIN DEPOSIT

Scout Holes Drilled by Percussion Drill.

NUMBERS PREFIXED BY "P"

P.14 0 - 5' Quartz & Iron stained Kaolinised Sandstone 5 - 15' Hard Kaolinised Sandstone 15 - 30' Kaolin, Soft.	P.15 0 - 5' Pink & Buff Kaolinised Sandstone 5 - 15' Hard White Kaolinised Sandstone 15 - 25' Soft White Kaolinised Sandstone 25 - 30' Buff Silica.
P.16 0 - 5' Red Brown Clay Soil, Trade Kaolin 5 - 10' Red Clay - Kaolinised Sandstone 10 - 15' Buff Kaolinised Sandstone 15 - 20' Buff Kaolinised Sandstone 20 - 25' White Kaolinised Sandstone 25 - 30' White Kaolin	P.17 Not complete as 'Open Cut' substituted for this hole.
P.19 0 - 5' Red Clay & White Kaolin mixture. High % Kaolin. 5 - 10' Cream Kaolin 10 - 15' Orange-White Kaolin** 15 - 20' Buff Kaolinised Sandstone, % Kaolin low.	P.21 0 - 5' Light Brown Clay Soil, then into white cream Kaolinised sandstone. 5 - 15' Buff Kaolinised Sandstone 15 - 25' White Kaolin
P.22 0 - 5' Dark brown sandy clay soil into iron stained Sandstone 5 - 10' Cream stained Kaolin 15 - 30' Buff Sandstone. % Kaolin low.	P.25 0 - 5' Brown Clay soil. Some Kaolin 5 - 10' Brown Clay toloose material. small % Kaolin. 10 - 20' Buff Kaolinised Sandstone 20 - 30' Buff Sandstone.
P. 26 0 - 5' Brown Sandy Soil. Trace Kaolinised Sandstone 5 - 30' White Kaolinised Sandstone	P. 27 0 - 5' Top Soil 5 - 10' Iron Stained Kaolinised Sandstone 10 - 15' Buff Kaolinised Sandstone 15 - 20' Yellow Sandstone
P.30 0 - 5' Red Brown Sandy Clay Soil 5 - 15' Buff Kaolinised Sandstone 15 - 30' Sandstone	

** P.19 Band of Discolouration.



LOCATION OF WILD CAT SCOUT HOLES

MAP 3

MOUNT CRAWFORD KAOLIN DEPOSIT

Wildcat Scout Holes Drilled by Proline Auger Drill.

HOLE NUMBERS PREFIXED BY "W"

See Map 3

W.1 0 - 10' Sand 10 - 15' Grey Sandy Clay	W.2 0 - 15' Very Sandy & Hard
W.3 0 - 6' Overburden 6 - 28' Off-white Clay Thin band Quartz at surface.	W.4 0 - 9' Overburden 9 - 30' White Clay
W.5 0 - 6' Overburden 6 - 30' White Clay	W.6 0 - 12' Overburden 12 - 45' White Clay - Sandy at top.
W.7 0 - 6' Overburden 6 - 30' White Clay Quartz Stringers at surface	W.8 0 - 6' Overburden 6 - 12' White Clay 12 - 27' Sandy Stained Clay
W.9 0 - 6' Overburden 6 - 24' White Clay 24 - 39' Stained Sandy Clay 39 - 60' White Clay	W.12 0 - 3' Overburden 9 - 21' White Clay, some Buff Sandy Clay.
W.13 0 - 3' Overburden 3 - 6' Sandy Rock & Quartz 6 - 18' White Clay	W.14 0 - 6' Overburden 6 - 16' White Clay 16 - 18' Red Stained Clay 18 - 30' White Clay
W.15 0 - 3' Overburden 3 - 12' Pink Iron Stained Clay 12 - 21' White Clay 21 - 24' Quartz Seam	W.16 0 - 6' Overburden 6 - 12' Sandy Clay 12 - 21' White Clay
W.17 0 - 6' Overburden 6 - 9' Buff stained Clay 9 - 12' Buff & Orange Clay 12 - 21' White Kaolin (Yellow seam at 20') 24 - 36' White Kaolin with Yellow sand 36 - 39' Sand	W.18 0 - 3' Overburden 6 - 9' Orange & Red Clay 12 - 18' Ironstone & Grey Clay 18 - 24' Red, Orange Sandy Clay

MOUNT CRAWFORD KAOLIN DEPOSIT

Wildcat Scout Holes Drilled by proline Auger Drill

HOLE NUMBERS PREFIXED BY "W"

W.19 0 - 6' Overburden 6 - 9' White Kaolin & Sand 9 - 21' Sand - some Kaolin	W.20 0 - 3' Overburden 3 - 9' Ironstained Kaolin 9 - 12' Grey Sandy Kaolin 12 - 18' Yellow Sandy Kaolin
W.21 0 - 3' Overburden 3 - 9' White Kaolin	W.22 0 - 3' Overburden 3 - 6' Red Clay 6 - 12' White Kaolin 12 - 21' Pink Kaolin (Mica 18 - 21')
W.23 0 - 3' Overburden 3 - 9' Red Kaolin 9 - 15' Pink Kaolin 15 - 27' White Kaolin	W.24 0 - 6' Overburden 6 - 9' Pink Kaolin 9 - 12' Light Pink Kaolin 12 - 33' White Kaolin
W.25 0 - 6' Overburden 6 - 24' Pink Kaolin	W.26 0 - 3' Brown Sandy Soil 3 - 6' Brown Sandy Clay Soil 6 - 9' Light Brown Sandy Clay Soil 9 - 12' Light Brown Bentdnitic Soil 12 - 15' Light Brown Clay 15 - 18' White Kaolin Clay 18 - 21' Brown Clay
W.27 0 - 3' Overburden 3 - 18' White, Hard Kaolinised Sandstone	W.28 0 - 3' Overburden 3 - 9' Buff Siliceous Kaolin 9 - 24' White Kaolinised sandstone
W.29 0 - 3' Overburden 3 - 9' Kaolin 9 - 12' Pink Siliceous Seam 12 - 24' White Kaolinised sandstone	W.30 0 - 9' Kaolinised Sandstone Hard. 9 - 12' Pink Buff Sandstone 12 - 24' Pink Buff Sandstone.
W.31 0 - 3' Overburden 3 - 18' White Kaolinised sandstone 18 - 21' Grey Kaolinised sandstone 21 - 24' Buff Kaolinised sandstone	W.32 Quartz stopped Drill at 4'

MOUNT CRAWFORD KAOLIN DEPOSIT

Wildcat Scout Holes Drilled by Proline Auger Drill

HOLE NUMBERS PREFIXED BY "W"

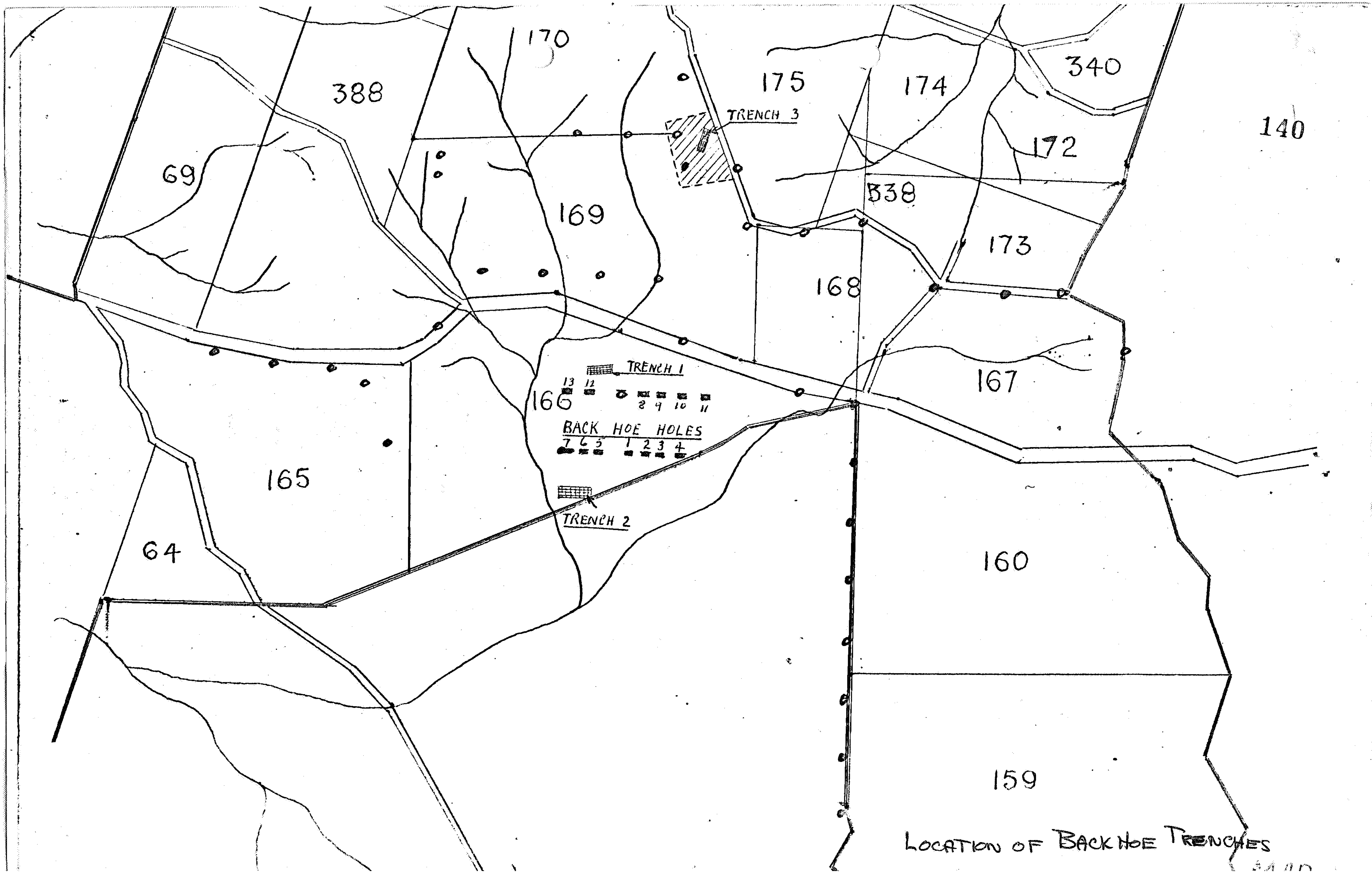
Hole	Depth	Description
W.32A	0 - 3'	Overburden
	3 - 6'	Kaolinised Sandstone Low % Kaolin
	6 - 24'	Buff Sand
W.33	0 - 3'	Overburden
	3 - 15'	Buff Siliceous material - Low % Kaolin.
W.34	0 - 3'	Overburden
	3 - 21	White Kaolinised Sandstone
	21 - 24	Siliceous
W.35	0 - 3'	Red Clay trace Kaolin
	6 - 9'	White Kaolinised Sand-stone
	9 - 15'	White Kaolin
	15 - 21'	Orange Sandy Kaolin
	21 - 24'	Buff-white Kaolin
W.36	0 - 6'	Brown Sandy Soil trace Kaolin
	6 - 9'	White Kaolin. Some Quartz.
	9 - 15'	White Kaolin
	15 - 21'	White Kaolin
	21 - 27'	Orange Sand
	27 - 36'	Buff Sand, trace Kaolin
W.37	0 - 3'	Brown Sandy Soil
	3 - 18'	Buff Sandstone
W.38	0 - 3'	Brown Clay Soil, Kaolin at 1'
	3 - 6'	White Kaolin
	6 - 18'	Buff stained Kaolin
	18 - 21'	Kaolinised Sandstone
	21 - 24'	Buff Sandstone
	24 - 27'	Micaceous Clay
W.39	0 - 3'	Red Brown Sandy Soil
	3 - 6'	Stain Kaolinised Sand-stone
	6 - 24'	Stain Kaolinised Sand-stone. % of Kaolin increasing.
W.40	0 - 3'	Brown Sandy Soil. Quartz evident
	3 - 6'	Red Brown Clay
	6 - 9'	Red Clay surface Kaolinised sandstone
	9 - 12'	Buff Kaolinised Sandstone
	12 - 18'	Buff Kaolinised Sandstone some Quartz
	18 - 24'	Hard Sandstone
W.41	0 - 3'	Red Clay Soil. Trace Kaolin
	3 - 6'	Buff Kaolin
	6 - 9'	White Kaolin
	9 - 12'	Buff Kaolin
	12 - 15'	Orange Sandy Kaolin
	15 - 18'	Buff Kaolin
	18 - 27'	White Kaolin
	27 - 33'	Buff Sandy Kaolin

MOUNT CRAWFORD KAOLIN DEPOSIT

Wildcat Scout Holes Drilled by Proline Auger Drill

HOLE NUMBERS PREFIXED BY "W"

W.42 Abandoned at 3'. Too hard for Proline	W.43 0 - 3' Brown Top Soil 3 - 9' Buff White Kaolin 9 - 18' Buff Kaolin 18 - 24' Buff-White Kaolin 24 - 27' Buff Kaolin 27 - 36' Buff Kaolin Quartz Stringer 33'
W.44 0 - 3' Brown Top Soil 3 - 6' Buff-Orange Kaolin 6 - 9' Sandy Buff Kaolin 9 - 12' White Kaolinised Sandstone 12 - 15' Orange Kaolinised Sandstone	W.45 0 - 3' Red-Brown Clay Soil 3 - 12' Buff Kaolin 12 - 18' White Kaolinised Sandstone
W.46 0 - 3' Red Sand 3 - 6' Red Orange Sand 6 - 9' Orange Sand 9 - 12' Yellow Sand	W.47 0 - 3' Brown Sandy Soil 3 - 15' Buff Kaolin 15 - 18' Buff Sand
W.48 0 - 3' Brown Sandy Top Soil 3 - 6' Hard Sandstone. Too Hard. Abandoned.	W.49 0 - 3' Orange Sand 3 - 6' Orange Kaolinised Sandstone Trace Kaolin. Too Hard. Abandoned.
W.50 0 - 3' Red Brown Clay Soil 3 - 12' Buff Kaolinised Sandstone. Too hard. Abandoned.	



LOCATION OF BACK HOE TRENCHES

SEE MAP 4

RECORDS OF TRENCHES DUG BY ROCHE BROS. 19R.B. BACKHOE.

TRENCH R.B.1.	99000 E / 99750 N	17/10/68	8·05am – 10·00am
0-5'	BROWN SANDY TOPSOIL. LOWER PART - BADLY STAINED GREY CLAY.		
5'-10'	WHITE TALCOSE CLAY, PATCHY IRONSTAINING.		
10'-15'	" " " " "		
15'-19'6"	WHITE - CREAM TALCOSE CLAY.		
R.B.2.	99100 E / 99750 N	17/10/68	10·15am – 12·50pm.
0-5'	BROWN SANDY TOPSOIL. LOWER PART GREY CLAY, SEVERELY STAINED.		
5'-10'	WHITE CLAY, SOME IRON STAINING, QUARTZ VEINS.		
10'-15'	WHITE CLAY IRONSTAINED, PATCH OF DARK GREY SOFT MATERIAL		
15'-19'6"	" " "		
R.B.3	99200 E / 99750 N	17/10/68	1·00pm – 2·10pm
0-5'	BROWN SANDY TOPSOIL, OFF WHITE CLAY BADLY STAINED.		
5'-10'	GREY CLAY, HARD AND VERY SANDY. TOO HARD TO CONTINUE.		
R.B. 4.	99300 E / 99750 N	17/10/68	2·10pm – 3·50pm
0'-5'	GREY BUFF SANDY CLAY UNDER TOPSOIL		
5'-10'	WHITE MEDIUM HARD QUARTZITE.		
10'-15'	SCHISTS AND GREY BUFF QUARTZITE, IRONSTAINED.		
15'-19'	HARD GREY QUARTZITE WITH SILLIMANITE		

TRENCH R.B. 5 98900 E / ~~B~~ 99750 N 17+18/10/68

0-5' BROWN TOPSOIL THEN WHITE AND GREY CLAY
BADLY IRONSTAINED.
TOO HARD.

R.B. 6 98850 E/99750 N 18/10/68

0'-5'	BROWN GREY TOPSOIL. WHITE CREAM IRONSTAINED CLAY
5'-10'	BROWN STAINED WHITE, CREAM HARD CLAY. SCHISTOSE.
10'-15'	WHITE HARD CLAY BADLY STAINED.
15-20'	" " " " "

R.B. 7 98750 E /99750 N 18/10/68.

0-5'	LIGHT BROWN TOPSOIL WITH MICACEOUS BROWN SAND BENEATH.
5'-10'	BROWN SANDY MICACEOUS SCHIST.
10'-15'	WHITE CLAY AND INTERLAMINATED SANDY MICA SCHISTS.
15'-20'	BROWN WHITE CLAY SCHIST WITH IRONSTAINING.

R.B. 8 99100 E /100000 N 18+19/10/68.

0-5'	LIGHT BROWN TOP SOIL, WHITE GREY CLAY BADLY STAINED.
5'-10'	CREAM BUFF SANDY CLAY, SOME IRON STAINING.
10'-15'	CREAM BUFF SANDY " " "
15'-19'6"	HARD SANDY <u>SILLIMANITE</u> QUARTZITE.

R.B. 9. 99200 E/ 100000 N 19/10/68

0'-5'	LIGHT BROWN SANDY TOPSOIL LOWER PART HARD SILLIMANITE QUARTZITE.
5'-7'	HARD <u>SILLIMANITE</u> QUARTZITE.

TOO HARD.

TRENCH R.B. 10 99,300 E / 100,660 N 19/10/68.

0 - 5'	LIGHT BROWN TOPSOIL
	LOWER PART HARD WHITE QUARTZITE.
5' - 10'	" " " .
10' - 15'	" BUFF, " " .

R.B. 11 99 400 E / 100,660 N 19/10/68.

0' - 5'	BROWN ORANGE STICKY CLAY.
5' - 7'	HARD WHITE, BUFF. QUARTZITE.

TOO HARD.

R.B. 12. 98 800 E / 100,660 N 19/10/68.

0' - 5'	LIGHT BROWN TOPSOIL, WHITE GREY BADLY STAINED CLAY.
5' - 10'	" " " " "
10' - 15'	BUFF SAND.
15' - 19'6"	" " .

R.B. 13 98 700 E / 100 000 N 19/10/68.

0' - 5'	LIGHT BROWN TOPSOIL TO ORANGE, YELLOW SAND.
5' - 10'	YELLOW SAND.
10' - 15'	LIGHT GREY SCHISTOSE CLAY.
15' - 20'	IRON STAINED SANDY SCHIST.

THE READYMIX GROUP CHEMICAL TESTING LABORATORY 144

STANDARD ANALYTICAL METHOD

MT CRAWFORD. KAOLIN/SILICA DEPOSIT.

Test Ref. No. A032 Readymix C.T.L. C7

Mr. A.W. HARDWICKE, 22nd OCTOBER, 1968

REGIONAL GENERAL MANAGER,

ADELAIDE.

REPORT A216/68.

YOUR REFERENCE: W.C. Drill Core Samples.

MATERIAL: Mt CRAWFORD CLAY MATERIAL.

WORK REQUIRED: Separation and quantitative determination of Clay & Silica sand fractions.

SAMPLE RECEIVED: 30-8-68.

SAMPLE IDENTIFICATION: HOLE: W4 & W5.

INVESTIGATION BY: S. LUDVIG.

RESULTS. -

SAMPLE NUMBER	ANALYTICAL REFERENCE NUMBER.	HOLE	DEPTH	% KAOLIN (CLAY) FRACTION	% SILICA SAND FRACTION	SAMPLE NUMBER	ANALYTICAL REFERENCE NUMBER.	HOLE	DEPTH	% KAOLIN (CLAY) FRACTION	% SILICA SAND FRACTION
68	0191	W4	0'-3'	53	47	77	0200	W4	27'-30'	68	32
69	0192	W4	3'-6'	62	38	78	0201	W4	30'-33'	61	39
70	0193	W4	6'-9'	62	38	79	0202	W4	33'-36'	51	49
71	0194	W4	9'-12'	60	40	80	0203	W5	0'-3'	51	49
72	0195	W4	12'-15'	58	42	81	0204	W5	3'-6'	43	57
73	0196	W4	15'-18'	64	36	82	0205	W5	6'-9'	45	55
74	0196	W4	18'-21'	67	33	83	0206	W5	9'-12'	36	64
75	0198	W4	21'-24'	65	35	84	0207	W5	12'-15'	36	64
76	0199	W4	24'-27'	66	34	85	0208	W5	15'-18'	42	58

THE READYMIX GROUP CHEMICAL TESTING LABORATORY

STANDARD ANALYTICAL METHOD

Test Ref. No. A032. Readymix C.T.L. C7

The Manager,
AUSTRALIAN BLUE METAL Pty. Ltd.,
ADELAIDE.

10th October, 1968.

REPORT A212/68.

YOUR REF: Mt. CRAWFORD W.C. DRILL SAMPLES.
MATERIAL: Mt CRAWFORD SANDSTONE,
WORK REQUIRED: DETERMINATION OF CLAY AND SILICA SAND FRACTIONS.
SAMPLES RECEIVED: 30th AUG, 1968.
SAMPLE IDENTIFICATION: HOLE NoS. 18A; 1; GR24; GR16.
INVESTIGATION BY: S. LUDVIG.

RESULTS: —

Sample Number	Analytical Reference Number	Hole	Depth	Kaolin (Clay) Fraction	Silica-Sand Fraction	Sample Number	Analytical Reference Number	Hole	Depth	Kaolin (Clay) Fraction	Silica Sand Fraction
33	0033	18A	0'-3'	58 %	42 %	51	0051	1	24'-27'	60 %	40 %
34	0034	18A	3'-6'	57 "	43 "	52	0052	1	27'-30'	38 "	62 "
35	0035	18A	6'-9'	54 "	46 "	53	0053	1	30'-33'	38 "	62 "
36	0036	18A	9'-12'	52 "	48 "	54	0054	1	33'-36'	38 "	62 "
37	0037	18A	12'-15'	48 "	52 "	55	0055	1	36'-39'	42 "	58 "
38	0038	18A	15'-18'	48 "	52 "	56	0056	GR24	0'-6'	44 "	56 "
39	0039	18A	18'-21'	48 "	52 "	57	0057	GR24	6'-9'	59 "	41 "
40	0040	18A	21'-24'	45 "	55 "	58	0058	GR24	9'-12'	54 "	46 "
41	0041	18A	24'-27'	44 "	56 "	59	0090	GR24	12'-15'	45 "	55 "
42	0042	18A	27'-30'	43 "	57 "	60	0091	GR24	15'-18'	52 "	48 "
43	0043	1	0'-3'	61 "	39 "	61	0092	GR16	0'-6'	54 "	46 "
44	0044	1	3'-6'	46 "	54 "	62	0093	GR16	6'-9'	47 "	53 "
45	0045	1	6'-9'	52 "	48 "	63	0094	GR16	9'-12'	47 "	53 "
46	0046	1	9'-12'	43 "	57 "	64	0095	GR16	12'-15'	51 "	49 "
47	0047	1	12'-15'	47 "	53 "	65	0096	GR16	15'-18'	48 "	52 "
48	0048	1	15'-18'	59 "	41 "	66	0097	GR16	18'-21'	45 "	55 "
49	0049	1	18'-21'	66 "	34 "	67	0098	GR16	21'-24'	41 "	59 "
50	0050	1	21'-24'	55 "	45 "	68	0099	Special	Sample	57 "	43 "

Outcrop Cap Stone [illegible]

ALL RESULTS BASED ON DRIED SAMPLES (105° C.).

THE READYMIX GROUP CHEMICAL TESTING LABORATORY

STANDARD ANALYTICAL METHOD

Test Ref. No. A032 Readymix C.T.L. C7.

Mr A.W. HARDWICKE, 9th Oct, 1968.
REGIONAL GENERAL MANAGER,

REPORT A210/68.

YOUR REF: W.C. DRILLING SAMPLES.
MATERIAL: Mt CRAWFORD CLAY MATERIAL.
WORK REQUIRED: DETERMINATION OF CLAY AND SILICA SAND FRACTIONS.
SAMPLE RECEIVED: 6th Oct, 1968.
INVESTIGATED BY: S. LUDVIG.
SAMPLE IDENTIFICATION: HOLE: GR 11 & W13.

RESULTS:

SAMPLE NUMBER.	ANALYTICAL REFERENCE NUMBER.	HOLE	DEPTH	KAOLIN (CLAY) FRACTION PER CENT	AVERAGE KAOLIN (CLAY) FRACTION PER CENT	SILICA SAND FRACTION. PER CENT	AVERAGE SILICA SAND FRACTION PER CENT
19	0090	W13	0-3	47·97 47·99	47·98	52·03 52·01	52·02
20	0091	W13	3-6	53·00 52·99	53·00	47·00 47·01	47·00
21	0092	W13	6-9	54·55 54·55	54·55	45·45 45·45	45·45
22	0093	W13	9-12	48·47 48·45	48·96	51·53 51·55	51·54
23	0094	W13	12-15	51·67 51·63	51·65	48·33 48·37	48·35
24	0095	W13	15-18	44·77 44·78	44·78	55·23 55·22	55·22
25	0096	W13	18-21	44·73 44·68	44·71	55·27 55·32	55·29
26	0097	GR 11	0-6	40·91 40·88	40·90	59·09 59·12	59·10
27	0098	GR 11	6-9	40·48 40·45	40·47	59·52 59·55	59·53
28	0099	GR 11	9-12	35·91 35·89	35·90	64·09 64·11	64·10
29	0100	GR 11	12-15	26·40 26·40	26·40	73·60 73·60	73·60
30	0101	GR 11	15-18	33·64 33·65	33·65	66·36 66·35	66·35
31	0102	GR 11	18-21	29·46 29·46	29·46	70·54 70·54	70·54
32	0103	GR 11	21-24	38·07 38·07	38·07	61·93 61·93	61·93

THE READYMIX GROUP CHEMICAL TESTING LABORATORY

~~STANDARD ANALYTICAL METHOD~~ 147

Test Ref. No. .... Readymix C.T.L. ....

Mr. A.W. HARDWICKE,
REGIONAL GENERAL MANAGER.

5th, October, 1968.

REPORT A 209/68.

YOUR REFERENCE: APPLICATION DATED; 4th Oct, 1968.

MATERIAL: Mt CRAWFORD KAOLIN/SAND.

WORK REQUIRED: DETERMINATION OF KAOLIN AND SILICA-SAND FRACTIONS.

SAMPLE RECEIVED: 4th OCT., 1968.

INVESTIGATION BY: S. LUDVIG.

RESULTS.

ALL RESULTS BASED ON DRIED SAMPLES. (105°C.)

SAMPLE NUMBER.	ANALYTICAL NUMBER.	TEST REF. No: R-C.T.L.	HOLE	DEPTH.	KAOLIN FRACTION PER CENT	SILICA SAND FRACTION. PER CENT
1	0076	A032 C7	GR12	6'-9'	77·05	22·95
2	0077	"	GR12	9'-12'	59·47	40·53
3	0078	"	GR12	12'-15'	53·47	46·53
4	0079	"	GR12	15'-18'	52·21	47·79
5	0080	"	GR14	9'-12'	67·04	32·96
6	0081	"	GR14	12'-15'	58·58	41·42
7	0082	"	GR14	15'-18'	52·90	47·10
8	0083	"	GR14	18'-21'	47·59	52·41
9	0084	"	GR17	9'-12'	46·52	53·48
10	0085	"	GR17	12'-15'	48·75	51·25
11	0086	"	GR17	15'-18'	57·70	42·30
12	0087	"	GR21	9'-12'	43·38	56·62
13	0088	"	GR21	12'-15'	47·56	52·44
14	0089	"	GR21	15'-18'	52·03	47·97

[redacted]

Test Ref. No. A032 Readymix C.T.L. C7.

Mr. A.W. HARDWICKE,
REGIONAL GENERAL MANAGER.

3rd October, 1968.

REPORT. A208/68.

YOUR REF: ROUTINE DETERMINATION OF CLAY AND SILICA-SAND FRACTIONS.

MATERIAL: Mt. CRAWFORD CLAY MATERIAL.

WORK REQUIRED: DETERMINATION OF CLAY (KAOLIN) AND SILICA-SAND FRACTIONS.

SAMPLE RECEIVED: 30th AUGUST, 1968.

INVESTIGATION BY: S. LUDVIG.

SAMPLE IDENTIFICATION: HOLE: W14. & W15.

RESULTS.

ALL RESULTS BASED ON DRIED SAMPLE (105°C.)

SAMPLE NUMBER	ANALYTICAL REFERENCE NUMBER	HOLE. (in Prices area)	DEPTH.	KAOLIN (CLAY) FRACTION PER CENT	AVERAGE KAOLIN (CLAY) FRACTION wt PER CENT	SILICA SAND FRACTION wt PER CENT	AVERAGE SILICA SAND FRACTION wt PER CENT
1	0069	W15	0'-3'	66·60 66·58	66·59	33·40 33·42	33·41
2	0070	W15	3'-6'	69·01 69·01	69·01	30·99 30·99	30·99
3	0071	W15	6'-9'	69·77 69·80	69·79	30·23 30·20	30·21
4	0072	W15	9'-12'	53·33 53·32	53·33	46·67 46·68	46·67
5	0073	W15	12'-15'	53·31 53·31	53·31	46·69 46·69	46·69
6	0074	W15	15'-18'	52·44 52·43	52·44	47·56 47·57	47·56
7	0075	W15	18'-21'	56·60 56·60	56·60	43·40 43·40	43·40

[redacted]

Test Ref. No.. Readymix C.T.L. ....

CONTINUED: REPORT A208/68.

SAMPLE IDENTIFICATION: HOLE W14.

SAMPLE NUMBER.	ANALYTICAL REFERENCE NUMBER.	HOLE.	DEPTH.	KAOLIN (CLAY) FRACTION. PER CENT	AVERAGE KAOLIN (CLAY) FRACTION PER CENT	SILICA SAND FRACTION. PER CENT	AVERAGE SILICA SAND FRACTION. PER CENT
1	0059	W14	0'-3'	66·50 66·49	66·50	33·50 33·51	33·50
2	0060	W14	3'-6'	66·29 66·27	66·28	33·71 33·73	33·72
3	0061	W14	6'-9'	65·96 65·95	65·96	34·04 34·05	34·04
4	0062	W14	9'-12'	61·76 61·72	61·74	38·24 38·28	38·26
5	0063	W14	12'-15'	65·74 65·73	65·74	34·26 34·27	34·26
6	0064	W14	15'-18'	68·12 68·10	68·11	31·88 31·90	31·89
7	0065	W14	18'-21'	69·04 69·03	69·04	30·06 30·07	30·06
8	0066	W14	21'-24'	67·61 67·60	67·61	32·39 32·40	32·39
9	0067	W14	24'-27'	73·74 73·67	73·71	26·26 26·33	26·29
10.	0068	W14	27'-30'	65·76 65·76	65·76	34·24 34·24	34·24

THE READYMIX GROUP CHEMICAL TESTING LABORATORY

REPORT A229/68. INTERNAL ANALYTICAL RESULTS

Date: 14th November, 1968.

Sample Description: Mt. CRAWFORD CLAY MATERIAL.

WORK REQUIRED: DETERMINATION OF CLAY (KAOLIN) AND SILICA SAND FRACTIONS.

RESULTS

INVESTIGATED BY: S. LUDVIG. Stephen Ludvig

Analytical Number	Sample Identification		ANALYSIS						
		%	%	%	%	%	%	%	%
			KAOLIN (CLAY)		SILICA-SAND				
0514	P.L.I. 0'-3'		95·6		4·4				
0515	P.L.I. 3 - 6'		80·4		19·6				
0516	P.L.I. 6'-9'		59·7		40·3				
0517	P.L.I 12'-15'		74·7		25·3				
0518	P.L.I. 15'-18'		67·3		32·7				
0519	P.L.I. 18'-21'		62·4		37·6				
0520	P.L.I. 21'-24'		70·7		21·3				
0521	P.L.I. 24'-27'		72·0		28·0				
0522	P.L.I. 27'-30'		81·7		18·3				
0523	P.L.I. 30'-33'		74·8		25·2				
0524	P.L.I. 33'-36'		76·3		23·7				
0525	P.L.I. 36'-39'		68·5		31·5				
0526	P.L.I. 39'-42'		74·3		25·7				
0527	18.B. 0'-3'		66·3		33·7				
0528	18.B. 3'-6'		43·4		56·6				
0529	18.B. 6'-9'		55·1		44·9				
0530	18.B. 9'-12'		62·3		37·7				
0531	18.B. 12'-15'		68·4		31·6				
0532	18.B. 15'-18'		57·6		42·4				
0533	18.B. 18'-21'		61·4		38·6				
0534	18.B. 21'-24'		52·3		47·7				
0535	18.B. 24'-27'		44·6		55·4				
0536	18.B. 27'-30'		52·6		47·4				
0537	18.B. 30'-33'		37·8		62·2				
0538	18.B. 33'-36'		31·7		68·3				
0539	18.B. 36'-39'		51·4		48·6				
[illegible]	18.B. 39'-42'		31·2		68·8				

THE READYMIX GROUP CHEMICAL TESTING LABORATORY

C.T.D. REPORT A229/68. INTERNAL ANALYTICAL RESULTS

Date:

Sample Description: Mt CRAWFORD CLAY MATERIAL.
CLAY (KAOLIN) AND SILICA SAND FRACTIONS.

RESULTS

Analytical Number	Sample Identification	ANALYSIS %	%	%	%	%	%	%	%
			KAOLIN. (CLAY)		SILICA SAND.				
0541	18.8 42'-45'		22·0		78·0				
0542.	18.8 45'-48'.		27·1		72·9				

 ENV 1082/1

SAND-KAOLIN DEPOSIT
MT. CRAWFORD, SO. AUSTRALIA

A PRESENTATION ON
KAISER REFRACTORIES
for
READY MIXED CONCRETE LIMITED
SYDNEY, AUSTRALIA

FEASIBILITY STUDY
PART I

OCTOBER 4, 1968

KAISER
REFRACTORIES

AUSTRALIAN BLUE METAL PTY LTD
287 CHURCHILL RD. PROSPECT.

AWJH.

Sand/Kaolin Deposit
Mt Crawford SA.

A PRESENTATION ON

KAISER REFRACTORIES

for

READY MIXED CONCRETE LIMITED

SYDNEY, AUSTRALIA

October 4, 1968

Feasibility Study
Part I

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*****

A PRESENTATION ON KAISER REFRACTORIES DIVISION OF KAISER ALUMINUM AND CHEMICAL CORPORATION

for

READY MIXED CONCRETE LIMITED
SYDNEY, AUSTRALIA

INTRODUCTION

Kaiser Refractories is a major division of Kaiser Aluminum and Chemical Corporation. Kaiser Industries owns approximately 33 percent of the common stock of Kaiser Aluminum & Chemical Corporation.

Kaiser Refractories produces a wide variety of high temperature, heat resistant materials that are used to line industrial furnaces in most basic industries where heat is employed during the manufacturing process. The Division operates nine domestic plants, two Australian facilities, and one plant in each of the countries of Canada and England. In size, Kaiser Refractories accounts for six percent of the sales of Kaiser Aluminum and Chemical Corporation and ranks among the top four refractory producers in the United States.

Refractories are produced in a variety of shapes, sizes, compositions and manufactured to specifications for a wide range of applications. Brick refractory products ((1) - 9" equivalent = (1) brick 9"L x 4½"W x 2½"T, priced in lots of 1,000 9" equivalents) account for the major tonnage sold; however, other products known as refractory specialties represent an increasingly greater portion of the market. Refractory specialties consist of mortars, cements, coatings, casting and ramming mixes, and materials which can be applied by pneumatic guns, in some cases, while the furnace is still hot.

The Steel Industry accounts for about sixty percent of Kaiser Refractories' sales. Steel producers use refractories of varying types in the open hearth furnace, the blast furnace, ladles, the basic oxygen steel furnaces, soaking pits, and other facilities where molten metal or heat containment is a factor.

Other major consumers of refractories are the Non-ferrous Industries, Foundries, and the Cement, Glass and Ceramic Industries. Refractories are also used by the Petro-chemical Industry, power producing facilities and in industrial incinerators. In fact, refractories are of paramount importance to practically every basic industrial process.

THE PAST

The Division started in 1942, when two California plants were constructed for the production of metallic magnesium. A quarry and calcining plant were established at Natividad, near Salinas, to mine and process dolomite. In addition, a seawater magnesia plant was built on the coast of Monterey Bay at Moss Landing. The first basic refractories plant was constructed at

Moss Landing in 1946. Further basic refractories facilities were added in 1956, at Columbiana, Ohio, to supply the refractory requirements of the Eastern market. At the same time, Midland, Michigan, was selected as the site for the production of periclase. Periclase is a fundamental ingredient used in the manufacture of basic refractories and is a high purity form of magnesium oxide made from seawater or other brine.

Kaiser Refractories acquired the Mexico Refractories Company, Mexico, Mo., in 1959. The Mexico organization had been in business since 1930, as a leading manufacturer of fireclay, high alumina and silica refractories....... materials which had not previously been produced by Kaiser. The Mexico organization brought to the Division major facilities at Mexico, Missouri; Frostburg, Maryland; Niles, Ohio and Oakville, Ontario, Canada.

In late 1965, the Division purchased the refractories business of The Denver Fire Clay Company of Denver, Colorado. The Denver plant manufactures fireclay and high alumina refractory products for consumers in the Rocky Mountain and Western areas.

THE PRESENT

During recent years, all of the plants of the Division have been either modernized and/or expanded. In fact, during the period 1965-66, construction reached an all-time high ($20,000,000) for the Division.

Presently, Kaiser Refractories maintains two research laboratories. One is a technical center which is located at Mexico, Missouri, and is primarily devoted to the development of new or improved fireclay and high alumina refractories. The second laboratory, located at Milpitas, California, is concerned primarily with basic refractory development. However, this group is also engaged in fundamental research projects for Kaiser and outside groups such as N.A.S.A. Within the past year, a group of seven engineers headed by Dr. R. E. Farris, has been formed to serve as the research and development nucleus for the diversification activities of the Division. This is in addition to the availability of the services of 60 scientists, research engineers and technicians that comprise the R&D personnel.

The research and development activities of the Division will soon be consolidated with the other corporate divisions at Pleasanton, California. The Corporation is constructing a campus-type, multi-million dollar unified research complex at this location. When completed late this year, the research center will bring together a staff of 400 which will provide, at one location, a wide range of scientific and engineering talent.

Thus, from a small metallic magnesium raw materials beginning, the Division has developed into a major producer of a complete line of refractory products. For example, the Division employs 100 different inorganic and organic raw materials in the compounding of over 400 product mixes. The 400 product mixes are processed into over 15,000 finished products. Availability of these

15,000 products is assured through a production capability of the following magnitude:

Basic Brick	23,000,000 9" Equivalents or	130,000 Tons
Basic Specialties		125,000 "
Fireclay, High Alumina and Silica Brick	75,000,000 9" Equivalents or	300,000 "
Fireclay, High Alumina Specialties		150,000 "
Deadburned Dolomite		50,000 "
Dolomitic Rock Products		80,000 "
Periclase (excluding Division consumption)		35,000 "
Magnesium Hydroxide (Paper Industry)		20,000 "
Magnesia (Paper Industry)		7,000 "
Magnesia (Air Pollution Abatement)		3,000 "
	TOTAL ANNUAL CAPACITY....	900,000 Tons

THE FUTURE

In searching for areas of growth in which the resources of the Division could be utilized, the Extender and Filler Pigment Industry was assumed to be a "fit". This assumption was corroborated upon the completion of an extensive United States and world market research project.

The market research project provided the Division with comprehensive knowledge of the Extender and Filler Pigment Industry in the following areas:

(1) The thirteen major and nine minor extender and filler pigments were identified.

(2) Total tonnage and value for each of the twenty-two extender and filler pigments was determined.

(3) Methods of mining, manufacturing and marketing for subject industry were determined as a "fit" with the talents of the Division.

(4) Product specifications for each major and minor (sub-classes of each were also determined) extender and filler pigments were determined.

(5) The major producers and their share of the market for extender and filler pigments were classified.

(6) Finally, a five-year project of sales growth and price stability, based on the consuming industries, was prepared.

It is because of such planning activity that we recognized and communicated to you the potential of the Mt. Crawford deposit. In addition, it is why the Division can be of assistance in developing the deposit.

The Division is actively pursuing opportunities in every phase of the extender and filler pigment field, with the exception of kaolin. Kaolin is being held in abeyance until you have reached a decision as to our participation in the Mt. Crawford project.

In concluding this section, we wish to stress that we are sincere in our desire to participate with you in the Mt. Crawford deposit. We feel that the next section of this presentation is indicative of our sincerity.

PROPOSED CAPITAL AND OPERATING COSTS

FOR

THE MT. CRAWFORD

SAND-KAOLIN DEPOSIT

SAND-KAOLIN DEPOSIT

MT. CRAWFORD, SOUTH AUSTRALIA

Preliminary data indicates that the Mt. Crawford sand-kaolin deposit has a number of interesting possibilities. Chemical and physical properties of the kaolin compare favorably with southeastern United States kaolin.

A number of drill samples have been received and work is progressing with their evaluation. It is anticipated that we shall have a cursory knowledge of the deposit concerning vertical and lateral uniformity from this testing. Also, these samples will indicate type of equipment for blunging, degriting, classification, dewatering, etc.

There are a number of plants in the United States that process kaolin, sand, and sand-kaolin. These plants vary in types of equipment depending on the ore and products produced. As an example, the southeastern United States kaolin producers use pit blunging and degriting (these deposits generally have less than 1% grit) and pump their slurry to plants through pipelines. Bleaching, classification, fractionating, dewatering, drying, etc., are designed to produce water washed kaolins mainly for the paper industry. A sand-kaolin plant in the Southwest produces glass sand and silica flour by froth flotation and spray dried kaolin for the ceramic industry. Another plant in western United States produce glass grade sand by froth flotation and refractory aggregate from the kaolin portion. Kaiser Refractories and Kaiser Engineers have made studies of all known plants producing kaolin and sands. Kaiser Engineers have designed plants and consulted in this area. Kaiser Refractories is operating a "wet" magnesia plant with similar equipment used to wet process kaolin (i.e. hydroclassifiers, thickeners, classifiers, filters, cyclones, dryers, calciners, etc.). Within the Kaiser organization we have complete experience in all ore dressing and beneficiation methods.

Capital and operating costs for the Mt. Crawford Project will be dependent on the following:

1. Type of plant (equipment)
2. Manufactured products
3. Plant capacity

1. TYPE OF PLANT

Plant selection shall depend on characteristics of ore and specifications of finished product.

2. MANUFACTURED PRODUCTS

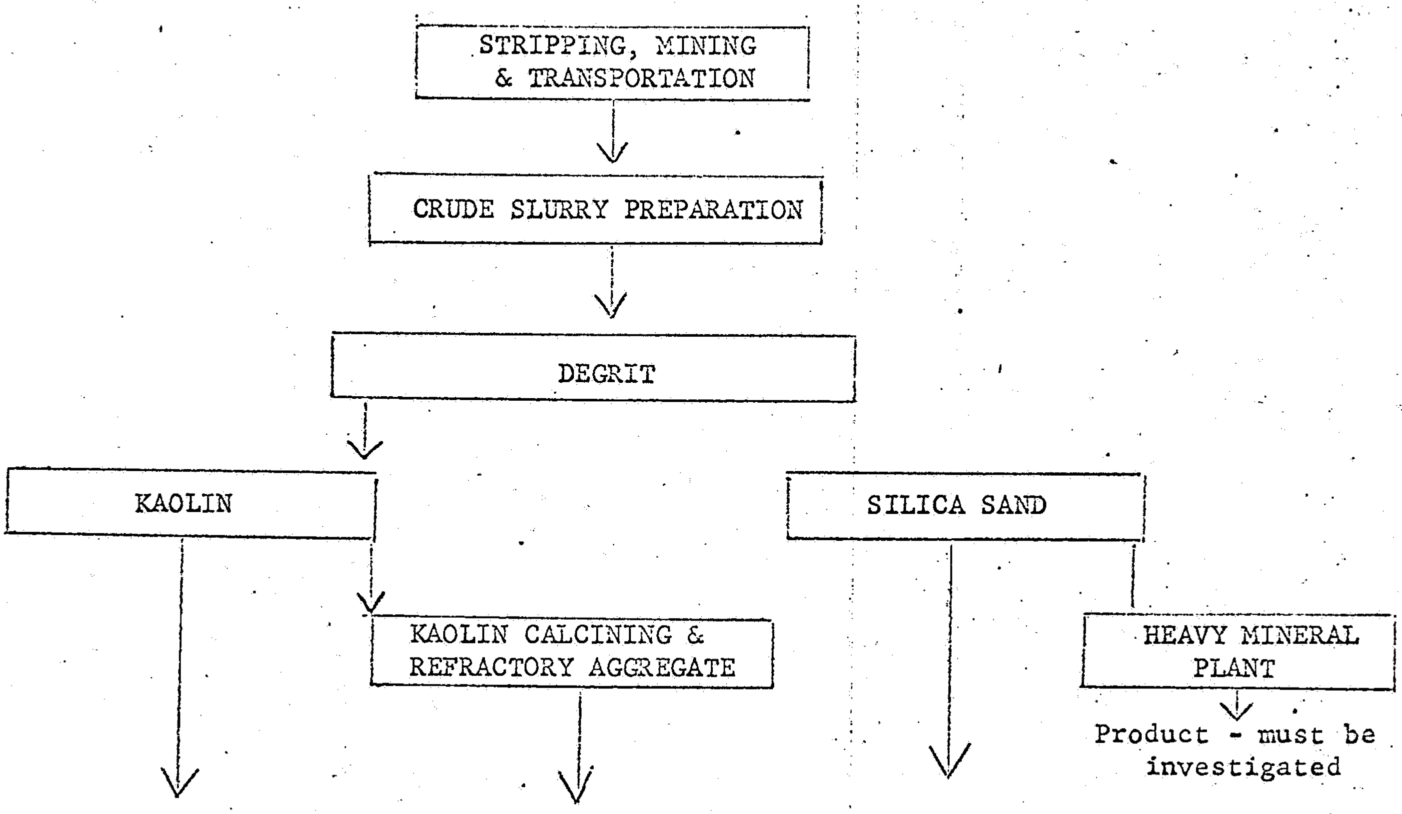
Products depend on properties of raw materials and marketing areas.

3. PLANT CAPACITY

Initial capacity and annual growth are dependent upon final marketing decisions. Industrial minerals are greatly affected by transportation methods and costs.

In order to estimate capital and operating cost for the Mt. Crawford Project, we have estimated annual capacities based on kaolin consumption within Australia, Japan and western United States. We have designed a "flowsheet" in sections. Should market or product research prove that a product is not economical, this section can be deleted from the plant.

GENERAL FLOW SHEET
SHOWING PLANT SECTIONS



*PRODUCT

Rotary Dried Kaolin-bulk
Rotary Dried Kaolin-bagged
70% Solid Slurry-bulk
Spray Dried-bulk
Spray Dried-bagged

*PRODUCT

Calcined Kaolin-bulk
Calcined Kaolin-bagged
Refractory Aggregate-bulk

*PRODUCT

Silica Sand-bulk
Silica Sand-bagged

*Specifications for grades of each type product must be determined by product research and market studies.

PRODUCTION

YR.	MINE PRODUCTION (1) TPY	TPD (250 DPY) SINGLE SHIFT	TPH	PRODUCT SAND (2)	KAOLIN (3) RAW (4)	CALC (5)	TOTAL (RAW BASIS)
1	136,000	544	68	71,000	35,000	15,000 (20M)	55,000
2	202,000	816	102	106,500	52,500	22,500 (30M)	82,500
3	272,000	1,088	136	142,000	70,000	30,000 (40M)	110,000
4	408,000	1,632	204	213,000	105,000	45,000 (60M)	165,000
5	544,000	2,176	272	284,000	140,000	60,000 (80M)	220,000

(1) Deposit mine run 55% sand, 45% kaolin
(2) 95% sand recovery
(3) 90% kaolin recovery
(4) 70% of kaolin product sold as raw, water-washed material (dry, spray-dried or slurry)
(5) 30% of kaolin market sold as calcined product. L.O.I. + Dust loss = 15% + 10% = 25%

NOTE: All tons expressed as long tons (2240 lbs./ton).

A flowsheet was designed for a "model" plant with great flexibility for product manufacture. Equipment costs, construction, fabrication and installation costs are from company engineering estimates. All costs are for U. S. manufactured equipment. Allowances for freight, duties, etc., were made. It is realized that some prices shall change subject to availability within Australia and different construction costs and practices. However, for a feasibility study, the costs shown herein are considered acceptable.

After study of equipment types and capacities it was determined that the initial plant capacity should serve production for the first three years.

During the third year the plant would be expanded to capacity shown for fourth and fifth year production.

INITIAL PLANT COST SUMMARY SECTION

	DIRECT (US$)	INDIRECT (US$)	TOTAL (US$)
Stripping, Mining and Transport	199,200		199,200
Crude Slurry Preparation	130,150	125,567	255,717
Degrit	156,405	150,980	307,385
Water Washed Kaolin	1,012,996	976,885	1,989,881
Kaolin Calcining & Refractory Aggregate	865,780	834,874	1,700,654
Silica Sand Section	417,968	403,111	821,079
General Plant	1,189,200	-	-
Misc. Construction	1,302,217	-	-
TOTAL..........	5,273,916	2,491,417	5,273,916

Direct costs in the various plant sections include equipment, installation, fabrication, etc. General plant includes site preparation, concrete, buildings, steel, office, shops, tailings disposal, utilities distribution, office and lab equipment, amenities, plant protection, etc.

Miscellaneous construction includes sales tax and duties, construction escalation, engineering design, field engineering and supervision, contingency, and capital spare parts.

Initial project could exclude various sections (i.e., sand section or kaolin calcining and refractory aggregate). These sections could be added at later date as product or market studies prove their justification.

INITIAL COST OF PLANT TO PRODUCE:

1. Water washed kaolin	$US	2,752,183
2. Water washed kaolin and calcined kaolin and refractory aggregate	$US	4,452,837
3. Water washed kaolin and silica sand	$US	3,573,262
4. Water washed kaolin, calcined kaolin and refractory aggregate, and silica sand	$US	5,273,916

Additional cost to expand plant to final capacity. It is anticipated that these costs will incur during third year of production.

Section	$US
Mining and Stripping	-0-
Crude slurry preparation	23,200
Degrit	-0-
Water washed kaolin	221,000
Kaolin calcining and refractory aggregate	-0-
Silica Sand	87,038
Total Additional Capital Cost $US	331,238

Final Capital Cost of plant after addition of equipment (544,000 tpy)

Section	$US
Mining and Stripping	199,200
Crude Slurry preparation	278,917
Degrit	307,385
Water washed kaolin	2,210,881
Kaolin calcining and refractory aggregate	1,700,654
Silica sand section	908,117
Total $US	5,605,154

ESTIMATE OF OPERATING COST

Payroll		Total Wage or Salary Incl. Holiday Pay, Payroll Tax, Worker's Compensation		
1	Manager	$A	12,000	annual
1	Chemist - Quality Control		7,000	
1	Sampler - Mine and Plant		3,075	
1	Maintenance Superintendent		5,000	
4	Mechanic-Welder @ 3,360		13,440	
2	Electrician @ 3,640		7,280	
3	Sample Prep. and Lab. @ 3,075		9,225	
1	Chief Clerk - Accountant		5,000	
1	Clerk - Secretary		4,000	
1	Warehouseman		4,000	
1	Utility Truck Driver		2,520	
3	Shift Foreman @ 4,500		13,500	
	Sub-Total-General Payroll	$A	86,040	

Mining (1 shift/day - 5 dpw)

2	Scraper Operator @ 3,910	$A	7,820
1	Utility Man		2,520
	Sub Total-Mining	$A	10,340

Degrit (1 shift/day - 5 dpw)

1	Operator @ 3,910	$A	2,910
1	Laborer @ 2,520		2,520
	Sub Total-Degrit	$A	5,430

Crude Slurry Preparation

1	Operator @ 3,910	$A	3,910
	Sub Total-Crude Slurry	$A	3,910

Silica Sand Section (1 shift/day - 5 dpw)

1	Sand Section Operator	$A	3,910
2	Bagging and Shipping @ 2,520		5,040
	Sub Total Sand Section	$A	8,950

Raw Kaolin Section (3 shifts/day - 5 dpw)
(Shipping - 2 shifts/day)

3	Raw Kaolin Section Operators @ 3,910	$A	11,730
6	Raw Kaolin Bagging & Shipping @ 2,520		15,120
	Sub Total Raw Kaolin	$A	26,850

ESTIMATE OF OPERATING COST (Cont'd)

Payroll		Total Wage or Salary Incl. Holiday Pay, Payroll Tax, Worker's Compensation	
Calcining & Refr. Agg. Section (3 shifts/day-7 dpw)		$A	
5	Operator @ 3,910	19,550	annual
5	Utility Man @ 2,520	12,600	
3	Bagging & Shipping (1 shift/day-5 dpw)	11,730	
	Sub Total Calc. & Refr. Agg. $A	43,880	
Miscellaneous			
2	General Plant Laborer @ 2,520	$A 5,040	
	Sub Total Misc. $A	5,040	
	TOTAL PAYROLL $A	190,440	

Pay Distribution

General	$A	86,040	annual
Mining and Stripping		10,340	
Crude Slurry Prep.		3,910	
Degrit		5,430	
Silica Sand		8,950	
Raw Kaolin		26,850	
Calc. & Refr. Agg.		43,880	
Misc.		5,040	
	$A	190,440	

Required Payroll to Produce:

1. Water Washed Kaolin — $A 137,610/annual
2. Water Washed Kaolin and Calcined Refractory Aggregate — $A 181,490/annual
3. Water Washed Kaolin and Silica Sand — $A 146,560/annual
4. Water Washed Kaolin, Calcined Kaolin and Refractory Aggregate, and Silica Sand — $A 190,440/annual

ELECTRICAL POWER

	Initial HP	Final HP	Hrs/ Yr.	Initial KW	Initial KWY	$A/Yr. @ 1.88¢ A/KWH
Stripping & Mining	0	0	2,000	0	0	0
Crude Slurry Prep.	76.5	91.5	2,000	52	104,000	1,955
Degrit Section	65.0	65.0	2,000	45	90,000	1,692
Raw Kaolin Sect.	576.5	746.5	6,000	392	2,352,000	44,217
Kaolin Calc. & Refr. Agg.	147.5	147.5	7,200	101	727,200	13,671
Silica Sand	502.0	702.0	2,000	342	684,000	12,859
Shop-Office-Misc.	118.0	118.0	2,000	80	160,000	3,000
	1485.5	1870.5	23,200	1012	4,117,200	77,402

Cost of Electric Power to Produce:

1. Water Washed Kaolin — $A 50,872/yr.
2. Water Washed Kaolin and Calcined Refractory Aggregate — $A 64,543/yr.
3. Water Washed Kaolin and Silica Sand — $A 63,731/yr.
4. Water Washed Kaolin, Calcined Kaolin and Refractory Aggregate and Silica Sand — $A 77,402/yr.

Water

Cost of Water to Mt. Crawford - 30¢/1000 gallons
1 Imp. Gallon = 10 lbs.
1 L.T. = 224 gallons
224/1000 x .30 = $A 0.067/L.T. Water

Crude Slurry Prep. - Degrit - Raw Kaolin
@ 2 L.T. Water/Ton Kaolin $A 0.134/ton

Calc. Kaolin and Refractory Aggregate Section
Cooling Water - 10 gpm or 1.2 tons
Water/ton Sand $A 0.078/ton

Silica Section
1 L.T. water/ton sand $A 0.067/ton

Cost of Reagents

Crude Slurry Preparation-Degrit-
Raw Kaolin Section

Deflocculant	$A 0.11
Flocculant	0.08
Deflocculant	0.38
TOTAL	$A 0.57/ton product

Refractory Aggregate	\$A 0.18/ton product

Silica Sand
  Xanthrate @ 30¢/lb. (0.05 lb.)
  Pine Oil @ 35¢/lb. (0.02 lb.)
  Soda Ash @ 2¢/lb. (4 lbs.)

	Total	\$A 0.09/ton product
Bags		\$A 1.50/ton product

MISC. PLANT SUPPLIES

	\$A/YEAR
Gasoline - Misc. Plant	4,000
Assay Supplies	3,000
Lubricants	5,000
Maintenance Parts	
Liners (2 years life)	4,000
Pumps	3,000
Conveyors	1,000
Flotation Cells	2,000
Blungers	2,500
Pipe and Plate	1,000
Other	5,000
Office Supplies	1,500
Phone, Postage, Cables, etc.	5,000
Total Misc.	\$A 37,000/year

Mine Equipment Operation:

Fuel	\$A 2.70/hr.
Lubricants-Filters	.55
Tires	2.70
Repairs	6.24
	12.19 x 4000 hrs./yr. = \$A 48,760/yr.

Bunker "C" Oil

\$A 27.10 per ton of 240 gal. = \$A 0.113/IMP. Gal.
1 US Gal. Bunker "C" Oil = 150,000 BTU
1 US Gal = 1.20094 IMP Gal.
1.20094 x 150,000 = 180,000 BTU/IMP Gal. or \$A 0.63/million BTU

Water Washed Kaolin - Spray Dried (60% solids to dry)	\$A 0.82/ton
Calcined Kaolin and Refractory Aggregate	\$A 2.52/ton
Sand Dryer	\$A 0.42/ton

RECAP

*DIRECT AND INDIRECT OPERATING COST

FIRST YEAR	$A/TON	$A/YEAR
17,500 tons spray dried kaolin - bulk	6.511	113,942
17,500 tons spray dried kaolin - bagged	8.011	140,192
7,500 tons calc. kaolin or refr. agg. - bulk	14.202	106,515
7,500 tons calc. kaolin or refr. agg. - bagged	15.702	117,765
35,500 tons silica sand - bulk	0.884	31,382
35,500 tons silica sand - bagged	2.384	84,632
	Total $A	594,428

SECOND YEAR	$A/TON	$A/YEAR
26,250 tons spray dried kaolin - bulk	4.849	127,286
26,250 tons spray dried kaolin - bagged	6.349	166,661
11,250 tons calc. kaolin or refr. agg. - bulk	10.682	120,172
11,250 tons calc. kaolin or refr. agg. - bagged	12.182	137,047
53,250 tons silica sand - bulk	0.782	41,641
53,250 tons silica sand - bagged	2.282	121,516
	Total $A	714,323

THIRD YEAR	$A/TON	$A/YEAR
35,000 tons spray dried kaolin - bulk	4.332	151,620
35,000 tons spray dried kaolin - bagged	5.832	204,120
15,000 tons calc. kaolin or refr. agg. - bulk	9.340	140,100
15,000 tons calc. kaolin or refr. agg. - bagged	10.840	162,600
7,000 tons silica sand - bulk	0.830	58,930
7,000 tons silica sand - bagged	2.330	165,430
	Total $A	882,800

FOURTH YEAR	$A/TON	$A/YEAR
52,500 tons spray dried kaolin - bulk	3.657	191,992
52,500 tons spray dried kaolin - bagged	5.157	270,742
22,500 tons calc. kaolin or refr. agg. - bulk	8.048	181,080
22,500 tons calc. kaolin or refr. agg. - bagged	9.548	214,830
106,500 tons silica sand - bulk	0.745	79,342
106,500 tons silica sand - bagged	2.245	239,092
	Total $A	1,177,078

*DIRECT AND INDIRECT OPERATING COST RECAP (Cont'd)

FIFTH YEAR

	$A/TON	$A/YEAR
70,000 tons spray dried kaolin - bulk	3.235	226,450
70,000 tons spray dried kaolin - bagged	4.735	331,450
30,000 tons calc. kaolin or refr. agg. - bulk	7.095	212,850
30,000 tons calc. kaolin or refr. agg. - bagged	8.595	257,850
142,000 tons silica sand - bulk	0.721	102,382
142,000 tons silica sand bagged	2.221	315,382
	Total $A	1,446,364

*Fixed costs (i.e., depreciation, property taxes and insurance) and Expense of Financing is not included in Direct and Indirect Operating Cost.

ENV 1082/1

170

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SAND-KAOLIN DEPOSIT
MT. CRAWFORD, SO. AUSTRALIA

FEASIBILITY STUDY
PART II

APRIL 1969

KAISER
REFRACTORIES

AUSTRALIAN BLUE METAL PTY LTD.
287 CHURCHILL RD. PROSPECT.

A.W.H.

SAND-KAOLIN DEPOSIT

MT. CRAWFORD, SO. AUSTRALIA

FEASIBILITY STUDY

PART II

April 1969

INDEX

SECTION I

FEASIBILITY STUDY

Sand-Kaolin Deposit
Mt. Crawford, South Australia

Feasibility Study
Part II
April 1969

A. Price, Brightness and Particle Size of Various Paper Grades of Water-Washed Kaolin

	Brightness	Particle Size, % Finer than 2 Microns	Price, $US/Ton Carload Bulk
Coating Grades			
Premium	88-92%	94-97%	$42.00/ST
No. 1	87	90-94	34.50
No. 2	86	80-83	26.50
No. 3	85	70-73	25.50
Filling Grades	80-84	30-65	14.50

B. U. S. Market for Water-Washed Kaolin as an Extender and Filler Pigment by End Use 1967 and 1972

	Tons (000 omitted)		$ (000 omitted)	
End Use	1967	1972	1967	1972
Adhesive	20.0	25.0	650	750
Paint	85.0	110.0	2,500	3,200
Paper	1,905.0	2,500.0	50,100	66,800
Plastics	20.0	30.0	500	800
Printing Ink	1.5	1.8	60	75
Putty,Caulk & Sealants	5.0	7.0	150	200
Rubber	20.0	25.0	800	1,000
Textile Coating & Backing	50.0	72.0	850	1,200
	2,106.5	2,770.8	$55,610	$74,025

C. Geographic Distribution of Consumption of Water-Washed Kaolin in the U.S.A.

Northeast	35%
North Central	35
South	20
West	10
	100

D. Kaolin Imports of Countries within Mt. Crawford Marketing Potential

1.	Japan	55,000 ST
2.	Australia	25,000 ST
3.	Pakistan	5,000 ST
4.	South Africa	2,000 ST
5.	Philippines	2,000 ST
6.	New Zealand	700 ST
7.	Korea	600 ST
8.	Malaysia, Thailand and Ceylon	300 ST
	TOTAL	90,600 ST

E. Total Mt. Crawford Marketing Potential 1972

1.	Western U. S.	277,000 ST
2.	Pacific Basic Countries	114,000 ST
	TOTAL	391,000 ST

To achieve one-third of this market would require premium, No. 1, No. 2 and No. 3 coating grades. In addition, it is believed that a substantial freight savings would be a necessary customer incentive to change to a new source of Kaolin.

F. Financial Analysis for the Production of Water-Washed Kaolin from the Mt. Crawford Sand-Kaolin Deposit

I General Assumptions

1. Projected Sales

a.	First year	35,000 ST Water-Washed Kaolin
b.	Second "	50,000 " " " "
c.	Third "	70,000 " " " "
d.	Fourth "	90,000 " " " "
e.	Fifth "	110,000 " " " "
f.	Sixth "	130,000 " " " "

II Cost of Good Produced
Note: Based on H. G. Fleshman's estimate as presented in the presentation of October 4, 1968.

1. Cost of Goods vs Production Levels

a.	35,000 ST	$US 14.50/ST
b.	50,000 "	11.00 "
c.	70,000 "	10.00 "
d.	90,000 "	9.00 "
e.	110,000 "	8.00 "
f.	130,000 "	8.00 "

III Transportation and Port Handling Costs

1. Transportation Costs from Mt.Crawford to Adelaide
   $U.S. 0.05/ST Mile x 35 miles = $US 1.75/ST

2. Port Adelaide Wharfage and Loading Costs

   Estimated at:

Wharfage	$US 0.75/S.T.
Loading	$US 1.00/S.T.
	$US 1.75/S.T.

3. U.S. Wharfage, Unloading and Storage Costs

   Estimated at:

Wharfage	$US 1.00/S.T.
Unloading	$US 1.50/S.T.
Storage	$US 1.00/S.T.
	$US 3.50/S.T.

IV Capital Estimate
Note: Based on H. G. Fleshman's estimate as presented in the presentation of October 4, 1968

1. Water-Washed Kaolin Plant excluding Calcining, Sand Preparation Plant, Development Costs and Working Capital

2. Water-Washed Kaolin Plant
   150 to 200,000 ST capacity = $US 2,800,000

V Royalty Payments

Ready Mix	$US 1.00/ST
Kaiser	$US 1.00/ST

VI Financial Calculations - SUMMARY

1. Case No. 1
   a. Product sells for $US 26.50/ST
   b. Payout = 6.84 years
   c. Return on Investment = 10%

2. Case No. 2
   a. Product sells for $US 34.50/ST
   b. Payout - 4.9 years
   c. Return on Investment = 25%

3. Case No. 3
   a. Product sells for $US 42.00/ST
   b. Payout = 4.02 years
   c. Return on Investment = 32.23%

FINANCIAL ANALYSIS - MT. CRAWFORD PROJECT

APRIL 1969

CASE NO. 1

(000's Omitted)

	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year
Tons Sold (ST)	35	50	70	90	110	130
Sales ($US 26.50/ST)	$928	$1,325	$1,855	$2,385	$2,915	$3,445
Cost of Goods	(508)	(550)	(700)	(810)	(880)	(1,040)
Transportation & Port Costs (excluding ocean freight)	(245)	(350)	(490)	(630)	(770)	(910)
Royalties	(70)	(100)	(140)	(180)	(220)	(260)
General Administrative & Selling (10%)	(93)	(133)	(186)	(239)	(292)	(345)
Gross Profit	$ 12	$ 192	$ 339	$ 526	$ 753	$ 890
Depreciation (20 Years, S.L.)	(140)	(140)	(140)	(140)	(140)	(140)
		(128)	(76)			
Profit Before Taxes	(128)	(76)	123	386	613	750
Taxes (50%)	-0-	-0-	(62)	(193)	(307)	(375)
Net Profit After Taxes	($128)	($ 76)	$ 61	$ 193	$ 306	$ 375
Cash Flow:						
Depreciation	$140	$ 140	$ 140	$ 140	$ 140	$ 140
Royalties After Taxes	35	50	70	90	110	130
Net Profit	-0-	-0-	61	193	306	375
Annual	$175	$ 190	$ 271	$ 423	$ 556	$ 645
Cummulative	$-0-	$ 365	$ 636	$1,059	$1,615	$2,260

Payout = 6 Years + $\frac{2,800 - 2,260}{645}$ = 6.84 Years

R.O.I. = 10%

MT. CRAWFORD PROJECT

FINANCIAL EVALUATION - RETURN ON INVESTMENT

APRIL 1969

CASE NO. 1

(000's Omitted)

Year	Investment	Income	Net Cash Flow	Disc. Fac. @ 8%	Present Value @ 8%	Disc. Fac. @ 11%	Present Value @ 11%
1	$2,800	$-0-	($2,800)	.962	($2,694)	.950	($2,660)
2		175	175	.892	156	.855	150
3		190	190	.825	157	.771	146
4		271	271	.764	207	.694	188
5		423	423	.707	299	.626	265
6		556	556	.655	364	.563	313
7		645	645	.607	392	.508	328
8		645	645	.562	363	.457	295
9		645	645	.520	335	.412	266
10		645	645	.481	310	.371	239
11-15 Avg.		645	645	.384	248	.274	177
16-20 Avg.		645	645	.261	168	.163	105
					$ +305		($ 188)

R.O.I. = 10%

FINANCIAL ANALYSIS - MT. CRAWFORD PROJECT

APRIL 1969

CASE NO. 2

(000's Omitted)

	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year
Tons Sold (ST)	35	50	70	90	110	130
Sales ($US 34.50/ST)	$1,208	$1,725	$2,415	$3,105	$3,795	$4,485
Cost of Goods	(508)	(550)	(700)	(810)	(880)	(1,040)
Transportation & Port Costs (excluding ocean freight)	(245)	(350)	(490)	(630)	(770)	(910)
Royalties	(70)	(100)	(140)	(180)	(220)	(260)
General Administrative & Selling (10%)	(121)	(173)	(242)	(311)	(380)	(449)
Gross Profit	$ 264	$ 552	$ 843	$1,174	$1,545	$1,826
Depreciation (20 Yrs., S.L.)	(140)	(140)	(140)	(140)	(140)	(140)
Profit Before Taxes	124	412	703	1,034	1,405	1,686
Taxes (50%)	(62)	(206)	(352)	(517)	(703)	(843)
Net Profit After Taxes	$ 62	$ 206	$ 351	$ 517	$ 702	$ 843
Cash Flow:						
Net Profit	$ 62	$ 206	$ 351	$ 517	$ 702	$ 843
Depreciation	140	140	140	140	140	140
Royalties After Taxes	35	50	70	90	110	130
Annual	$ 237	$ 396	$ 561	$ 747	$ 952	$1,113
Cummulative	$ -0-	$ 633	$1,194	$1,941	$2,893	$4,006

$$\text{Payout} = 4 \text{ Years} + \frac{2,800 - 1,941}{952} = 4.9 \text{ Years}$$

R.O.I. = 25%

MT. CRAWFORD PROJECT

FINANCIAL EVALUATION - RETURN ON INVESTMENT

APRIL 1969

CASE NO. 2

(000's Omitted)

Year	Investment	Income	Net Cash Flow	Disc. Fac. @ 24%	Present Value @ 24%	Disc. Fac. @ 26%	Present Value @ 26%
1	$2,800	$ -0-	($2,800)	.900	($2,520)	.893	($2,500)
2		237	237	.725	172	.708	168
3		396	396	.586	232	.563	223
4		561	561	.471	264	.446	250
5		747	747	.381	285	.354	264
6		952	952	.307	292	.282	268
7		1,113	1,113	.247	275	.223	248
8-20 Cummulative		1,113	1,113	.969	1,078	.815	907
					$ +78		$ -172

R.O.I. = 24.6%

FINANCIAL ANALYSIS - MT. CRAWFORD PROJECT

APRIL 1969

CASE NO. 3

(000's Omitted)

	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year
Tons Sold (ST)	35	50	70	90	110	130
Sales ($US 42.00/ST)	$1,470	$2,100	$2,940	$3,780	$4,620	$5,460
Cost of Goods	(508)	(550)	(700)	(810)	(880)	(1,040)
Transportation & Port Costs	(245)	(350)	(490)	(630)	(770)	(910)
Royalties	(70)	(100)	(140)	(180)	(220)	(260)
General Administrative & Selling (10%)	(147)	(210)	(294)	(378)	(462)	(546)
Gross Profit	$ 500	$ 890	$1,316	$1,782	$2,288	$2,704
Depreciation (20 Yrs., S.L.)	(140)	(140)	(140)	(140)	(140)	(140)
Profit Before Taxes	360	750	1,176	1,642	2,148	2,564
Taxes (50%)	(180)	(375)	(588)	(821)	(1,074)	(1,282)
Net Profit After Taxes	$ 180	$ 375	$ 588	$ 821	$1,074	$1,282
Cash Flow:						
Net Profit	$ 180	$ 375	$ 588	$ 821	$1,074	$1,282
Depreciation	140	140	140	140	140	140
Royalties After Taxes	35	50	70	90	110	130
Annual	$ 355	$ 565	$ 798	$1,051	$1,324	$1,552
Cummulative	$ -0-	$ 920	$1,718	$2,769	$4,093	$5,645

$$\text{Payout} = 4 \text{ Years} + \frac{2,800 - 2,769}{1,324} = 4.02 \text{ Years}$$

R.O.I. = 32.23%

MT. CRAWFORD PROJECT

FINANCIAL EVALUATION - RETURN ON INVESTMENT

APRIL 1969

CASE NO. 3

(000's Omitted)

Year	Investment	Income	Net Cash Flow	Disc. Fac. @ 30%	Present Value @ 30%	Disc. Fac. @ 35%	Present Value @ 35%
1	$2,800	$ -0-	($2,800)	.880	($2,464)	.864	($2,419)
2		355	355	.676	240	.640	227
3		565	565	.521	294	.474	268
4		798	798	.400	319	.351	280
5		1,051	1,051	.308	324	.260	273
6		1,324	1,324	.237	314	.193	256
7		1,552	1,552	.182	282	.142	220
8-20 Cummulative		1,552	1,552	.587	911	.400	621
					$ +220		$ -274

R.O.I. = 32.23%

SECTION II

CHRONOLOGICAL LAB REPORTS

KAISER REFRACTORIES
INTER-OFFICE MEMORANDUM

To S. D. Shopher

Date March 31, 1969

From M. E. Green
At Milpitas M. E. Green

Copies To R. E. Farris M. C. McQuarrie
J. C. Hicks
G. A. Tyler
M. L. Van Dreser

Subject Australian Kaolin, Mt. Crawford Deposit, Pits #3 and #4

bcc: J. F. Knight

Project 16020

ABSTRACT - The Mt. Crawford sandy kaolins from Pits #3 and #4 consist of kaolinite with pyrophyllite, quartz, and plagioclase impurities. The samples were successfully beneficiated by the hydrocyclone, particularly with respect to the quartz content. The brightnesses of the beneficiated kaolins were comparable to those of domestic paper grade kaolins.

Two samples of the sandy kaolin from the Mt. Crawford deposit were received from the Readymix Group (S.A.) for analysis. These samples were labeled Pit #3 and Pit #4. It was understood that the Pit #3 sample was similar to the original open cut sample analyze earlier (I.O.M., R. E. Farris, 5/8/68). Both Pit #3 and #4 samples had been beneficiatec by the Readymix Group. This beneficiation process consists of removal of quartz by a wet 200 mesh screening procedure and filtering and drying the -200 mesh kaolin product. However, the original open cut sample was not beneficiated prior to our analysis.

The samples from Pit #3 and Pit #4 were hammer-milled, slurried (25% kaolin -75% H_2O), blunged for 4 hours, and separated on the 25mm. hydrocyclone at 60 psi into underflow (coarse) and overflow (fine) fractions. The ratio of solids in the separated fractions was approximately 3:1 (overflow:underflow). The overflow slurries were filter-pressed at 90 psi and the filter cake products were dried.

A sample of each overflow material was bleached utilizing a procedure recommended by Dr. C. L. Garey of The Institute of Paper Chemistry. The overflow samples (bleached and unbleached) were analyzed for brightness on the Gardner Reflectometer. This new instrument has not been completely calibrated but the results should be accurate to within ±2%. The results of the brightness measurements and the X-ray analysis are shown in the attached table.

The mineralogical compositions of the Pit #3 and #4 overflow samples were very similar to the -325 mesh portion of the original open cut sample with the exception of the quart: content. The lower quartz content of the Pit #3 and #4 samples is probably due to prior beneficiation in Australia. The major impurity in all samples was pyrophyllite which lowers the overall alumina-silica ratio. Excluding pyrophyllite, which seems to be interlayered with the kaolinite as in previous samples from the Mt. Crawford deposit (I.O.M., M. E. Green, 11/14/68), the hydrocyclone procedure seems to successfully beneficiate the sandy kaolins. This procedure produced a quartz separation at approximately 50 microns in these materials.

S. D. SHOPHER
APR 3 1968
REFRACTORIES DIV.

The brightness results indicate that the overflow samples have reflectivities that are comparable to those of domestic paper grade kaolins, many of which have to be bleached or otherwise treated to reach that level. The bleaching method attempted on the overflow samples produced insignificant results. The pyrophyllite impurity levels would not apparently hinder the use of the Pit #3 and Pit #4 kaolins as fillers. Although pyrophyllite is not present in most domestic paper grade kaolins, analysis of high grade foreign papers indicates extensive use of pyrophyllite-containing kaolins (per Dr. C. L. Garey).

TABLE I

MT. CRAWFORD KAOLINS, PITS #3 AND #4

	Pit #3		Pit #4		Open Cut	
	Overflow	Underflow	Overflow	Underflow	-325	+325
Kaolinite	>75	<40	>85	<30	~75-85	~4
Pyrophyllite	~15	~40	~5	~35	~10-20	-
Quartz	~1	~20	~1	~20	~5	~94
Plagioclase	~1	~1	~4	~15	-	-
Talc	-	-	-	-	~1	~2
Brightness (% of MgO)						
Unbleached	~90		~86			
Bleached	~89		~87			

MEG:ls

REFRACTORIES DIVISION LABORATORY 186 S. D. SHOPHER

LABORATORY SERVICES REPORT JAN. 24 1969

REFRACTORIES DIV.

To: M. L. Van Dreser

CC: Section Head
Submitter
J. Bowman M. Green
H. G. Fleshman S. D. Shopher

Date: January 15, 1969

From: Wm. Boyer WB

Subject: Australian Clay

Type Service: [ ] Chemical [X] Petrographic [X] X-Ray [ ] Photographic [ ] Physical Tes

Project Number: 6900-806-T Priority: 2 Time Charge 8 Hrs. Serial Number: X69-2

Submitted By: R. Farris Section Head: R. Farris

Date Received: 1/8/69 Date Completed: 1/15/69

Sample Number: 4579

Sample Description: Small bottle of minus 100 mesh clay material from Mt. Crawford, South Australia.

ABSTRACT: The Australian clay (sample 4579) is a poorly crystalline Koalinite or partially crystalline Halloysite. Plagioclase feldspar is the major non-Kaolin phase.

The Australian clay sample, reported to be a Bentonite, contains the following mineral phases:

Kaolinite ($Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$)	Major
Plagioclase ($Na_2O \cdot Al_2O_3 \cdot 6SiO_2$ - $CaO \cdot Al_2O_3 \cdot 2SiO_2$)	~5 to 10%
Pyrophyllite ($Al_2O_3 \cdot 4SiO_2 \cdot H_2O$)	Trace
Rutile (TiO_2)	Trace

The Kaolinite XRD pattern is quite weak, with considerable line broadening. This feature indicates poor crystallinity or a largely amorphous material. A DTA curve of the material approaches that of Halloysite, an amorphous Kaolin composition containing more water.

The sample is not a Bentonite.

WB:jg

References:

LS— 1-2-64

S. D. SHOPHER
187 NOV 25 1968
REFRACTORIES DIV.

KAISER REFRACTORIES
INTER-OFFICE MEMORANDUM

To S. D. Shopher

Date November 14, 1968

From M. E. Green
At Milpitas M. E. Green

Copies To R. E. Farris, H. G. Fleshman, J. C. Hicks, J. F. Knight, M. C. McQuarrie, M. L. Van Dreser

Subject Australian Clay, Mt. Crawford Deposit

Project 607-1577

ABSTRACT - The mineralogy and chemistry of the Mt. Crawford deposit indicate that it may be a primary deposit in various stages of kaolinization. Complete beneficiation of the primary minerals from the kaolin appears to be virtually impossible. Analysis of a second, well - identified, uncontaminated lot of samples must be made prior to a firm conclusion on the value of the deposit.

INTRODUCTION

Several samples of kaolin - quartz materials from a deposit in the Mt. Crawford area in South Australia were received from The Readymix Group (S.A.) for analysis. These consisted of auger - drilled samples taken from an area of about one square mile around the initial open cut area from which a single previous sample had been analyzed at Milpitas. Previous work on the initial open cut sample ("Australian Clay", R.E.F., 5/8/68) indicated that the particle size distribution and chemical analysis of the -325 mesh fraction which was predominantly kaolin, were comparable to those of commercial kaolins. The sample contained small amounts of talc and rutile.

The deposit was described as consisting of nearly equal portions of coarse (+325) quartz and fine (-325) kaolin that should be easily separable. It was originally anticipated that the quartz portion could be utilized as glass sand while the kaolin portion could be used for refractories or filler applications such as in the paint and paper industries.

The current auger - drilled samples were analyzed in order to further characterize the mineralogy, feasibility of beneficiation, and extent of the deposit. However, since the samples received had no elevation designations and were not coordinated with any orderly geographical sampling pattern, any estimate of the shape or volume of the deposit would be impossible. Two open cut samples were separated using the hydro-cyclone method in an attempt to determine the efficiency of this beneficiation technique on this type of material.

TESTS

A 50% slurry of each raw sample was violently blunged for 15 minutes on the paint - shaker apparatus. Additional blunging, up to 120 minutes, did not produce enough extra sample breakdown to justify the extra blunging. The blunged slurry was then washed through a 325 mesh screen and both portions were dried. The percentages of +325 mesh and -325 mesh material for each sample are tabulated in Table I. The dried -325 mesh fractions were reground, using a mortar and pestle, and used for particle size determinations (M.S.A. Whitby method) and mineralogical analysis. All the -325 mesh samples were analyzed for phase composition. The results, as crude quantitative percentages, are listed in Table I with the pyrophyllite percentages possibly being low by as much as a factor of two. ("Australian Clay", W.H.B., 10/17/68).

Selected +325 mesh samples were mineralogically analyzed and the results are listed in Table II where 1 = most abundant mineral, 2 = second most abundant mineral, etc. Chemical analyses, shown in Table III, were also made on selected +325 mesh and -325 mesh samples to aid mineralogical identification. Two 10% slurries of open cut material were separated using a 25 mm. hydrocyclone at 40 psi slurry pressure which gave a separation at about 10 microns. The mineralogy of the cycloned samples is shown in Table V (crude quantitative percentages) where the overflow is the fine portion of the -100 mesh beneficiated material.

RESULTS

The auger - drilled samples showed a large variation in amount of -325 mesh material, which ranged from 11.1 to 85.8% depending on hole and depth. The mineralogical composition of both the +325 mesh and -325 mesh samples was extremely varied both among and within holes. All the -325 mesh samples were primarily kaolinite with pyrophyllite as the major impurity and quartz, plagioclase felspars, and muscovite as the minor impurities. Conversely, the most abundant mineral in the +325 mesh fractions was varied, being either kaolinite, quartz pyrophyllite, or plagioclase depending on location of hole and depth.

In the -325 mesh samples muscovite was generally present only as a trace mineral and plagioclase, when it was present, usually increased near the bottoms of the holes. Quartz was present in varying amounts in all holes whereas pyrophyllite was the major non-kaolin phase in most holes but was nearly absent in a few samples. The only relatively clean hole were holes #W13 and W14. Correspondence from The Readymix Group suggested that the samples could have been contaminated due to the drilling method and to wash down from excessive rain during sampling. Their analysis indicated that some holes, such as #W13, consisted of a ball clay underlying the kaolin material.

Chemical analyses on selected samples showed large variations in alumina - silica ratios and in amounts of impurities and L.O.I. The particle size determinations on selected -325 mesh samples indicated that they were essentially finer than 20 microns and in general were slightly more coarse than a standard kaolin.

The beneficiation procedure using the hydro-cyclone succeeded in eliminating about two-thirds of the non-kaolin materials from the -100 mesh portion of two open cut samples. However, the beneficiated fraction, or overflow, amounted to only about one - fourth of the total sample in each case. The presence of some residual non-kaolin phases after beneficiation supports the petrographic analysis that some of the impurities are very small and perhaps intergrown layer-wise with the kaolin material.

CONCLUSIONS

The overall petrographic analysis suggests that the Mt. Crawford deposit may be a primary deposit that is in various stages of hydrothermal weathering, or kaolinization. This is suggested by the felspars and mica in the deeper samples and the general presence of quartz and pyrophyllite in nearly all samples. Both the kaolinite and the primary mineral impurities are present in a range of particle sizes from +100 mesh down to less than 10 microns. Complete beneficiation of all non-kaolin materials from the -325 mesh kaolinite may be virtually impossible due to their particle size and layered structure.

Due to possible contamination from sampling techniques, no firm conclusion on the value of the Mt. Crawford deposit can be reached until a second lot of auger - drilled samples, well - identified and uncontaminated, are analyzed.

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TABLE I

MINERALOGY (-325 Fraction)

Hole:	Depth	%-325	Kaolinite	Pyrophyllite	Quartz	Plagioclase	Muscovite
Open cut		39.1	91	6	3	-	-
1	12-15	40.3	81	15	4	-	-
1	15-18	44.5	82	12	6	-	-
1	18-21	42.3	80	12	8	tr	-
3	9-12	41.4	85	12	3	tr	-
3	12-15	40.0	85	12	3	-	-
3	15-18	44.3	75	15	5	5	-
6	6-9	54.2	89	6	5	-	-
6	9-12	50.9	89	6	5	-	-
6	12-15	32.6	87	9	4	-	-
6	15-18	36.5	86	9	5	-	-
6	18-21	46.6	85	12	3	-	-
7	9-12	32.3	92	3	5	-	-
7	12-15	31.7	90	3	7	tr	-
7	15-18	33.8	81	12	7	-	-
7	18-21	38.1	82	12	6	-	-
8	9-12	28.4	67	30	3	tr	-
8	12-15	22.2	76	21	3	tr	-
8	15-18	19.4	70	21	5	4	-
8	18-21	21.7	72	21	5	2	-
13	6-9	34.6	90	3	7	-	-
13	9-12	36.8	92	3	5	tr	tr
13	12-15	40.0	92	tr	8	-	tr
13	15-18	40.9	93	tr	7	tr	tr
13	18-21	52.3	93	tr	7	tr	tr
14	9-12	37.4	87	3	10	tr	-
14	12-15	38.1	92	tr	8	-	tr
14	15-18	41.9	89	6	5	-	-
14	18-21	40.5	94	tr	6	tr	tr
16	9-12	32.3	79	12	9	-	-
16	12-15	45.7	89	6	5	-	tr
16	15-18	43.8	80	3	8	-	9
16	18-21	43.2	88	6	6	-	-
18	12-15	19.3	72	15	7	6	-
18	15-18	21.3	73	15	9	3	-
18	18-21	11.1	71	15	10	4	-
18	21-24	13.4	78	12	7	3	-
18	30-33	22.9	84	6	7	3	-
18	33-36	20.6	61	21	10	8	-
18	36-39	21.1	80	9	7	4	-
18	39-42	13.4	72	12	9	7	-
18	42-45	13.9	67	12	11	10	-

TABLE I (Continued)

Hole:	Depth	%-325	Kaolinite	Pyrophyllite	Quartz	Plagioclase	Muscovi
19	12-15	17.8	68	21	11	-	-
19	15-18	16.5	60	30	10	-	-
19	18-21	19.2	68	21	11	-	-
20	6-9	35.9	83	12	5	-	-
20	9-12	37.4	75	18	7	-	-
20	12-15	46.9	94	3	3	-	-
20	15-18	48.1	75	tr	10	15	-
21	6-9	27.9	83	12	5	-	-
21	9-12	37.8	85	6	9	tr	-
21	12-15	32.2	62	3	5	30	-
W4	18-21	32.0	74	18	8	-	-
W4	21-24	37.3	84	12	4	-	-
W4	24-27	35.9	83	15	2	-	-
W4	27-30	31.9	87	9	4	-	-
W4	30-33	30.5	85	12	3	-	-
W4	33-36	29.2	84	12	4	-	-
W14	12-15	47.8	97	-	3	-	-
W14	15-18	52.9	97	tr	3	-	-
W14	18-21	51.6	97	tr	3	-	-
W14	21-24	54.6	96	tr	4	-	-
W14	24-27	55.1	97	-	3	-	-
W14	27-30	43.3	97	-	3	-	-
W15	12-15	38.0	83	12	2	3	-
W15	15-18	34.4	84	12	3	1	-
W15	18-21	38.1	91	3	5	1	-
W13	0-3	85.8	98	tr	2	-	-
W13	3-6	50.4	98	tr	2	-	-
W13	6-9	46.0	100	tr	-	-	-
W13	9-12	48.1	95	3	2	-	-
W13	12-15	51.3	92	6	2	-	-
W13	15-18	57.9	87	9	3	1	-
W13	18-21	75.8	97	tr	1	2	-
W13	24-27	77.1	96	3	tr	1	-
W13	27-30	72.0	90	3	3	4	-
W13	30-33	77.6	99	tr	tr	1	-
W13	33-36	76.1	97	tr	tr	3	-
W13	36-39	57.0	98	tr	-	2	-
W13	39-42	55.7	93	tr	1	6	-

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TABLE I (Continued)

Hole:	Depth	%-325	Kaolinite	Pyrophyllite	Quartz	Plagioclase	Muscovite
18A	3-6	45.5	95	3	2	-	-
18A	6-9	41.2	90	6	4	-	-
18A	9-12	39.1	87	9	3	1	-
18A	12-15	38.3	88	6	6	-	-
18A	15-18	38.8	90	6	4	-	-
18A	18-21	39.3	82	15	3	-	-
18A	21-24	32.3	81	15	4	-	-
18A	24-27	36.5	84	12	4	-	-
18A	27-30	32.8	74	18	5	3	-
18B	9-12	39.4	90	6	3	1	-
18B	12-15	34.4	84	12	3	1	-
18B	15-18	35.4	87	9	3	1	-
18B	18-21	41.8	93	3	3	1	-
18B	21-24	39.6	92	3	-	5	-
1A	3-6	38.3	82	12	5	1	-
1A	6-9	32.1	79	12	8	1	-
1A	9-12	38.6	80	9	9	2	-
1A	12-15	41.8	74	18	7	1	-
1A	15-18	45.9	86	6	7	1	-
1A	18-21	41.0	88	3	8	1	-
1A	21-24	57.1	84	9	6	1	-
1A	24-27	49.4	80	12	6	2	-
1A	27-30	25.7	84	6	8	2	-
1A	30-33	24.1	80	6	10	4	-
1A	33-36	28.1	65	18	9	8	-
1A	36-39	23.1	73	12	8	7	-

TABLE II

MINERALOGY (/325 Fraction)
Selected Samples

Hole:	Depth	Kaolinite	Pyrophyllite	Quartz	Plagioclase
8	9-12	tr	1	2	3
18	12-24	tr	1	3	2
18	30-45	tr	1	2	3
19	15-18	-	2	1	3
W13	0-3	1	-	tr	-
W13	3-6	1	-	-	-
W13	6-9	1	-	-	-
W13	9-12	1	tr	-	-
W13	12-15	1	2	3	4
W13	15-18	3	2	4	1
W13	18-21	1	2	tr	3
W13	24-27	2	3	tr	1
W13	27-30	2	-	-	1
W13	30-33	tr	tr	tr	1
W13	33-36	-	tr	tr	1
W13	36-39	tr	tr	tr	1
W13	39-42	-	-	-	1

TABLE III

CHEMICAL ANALYSES

	Hole 8 9-12 (-325)	Hole 18 42-45 (-325)	Hole 19 15-18 (-325)	Hole 21 12-15 (-325)	Hole 8 9-12 (/325)	Hole 18 42-45 (/325)
Al_2O_3	32.90	22.35	27.70	31.16	8.37	10.60
SiO_2	50.05	66.25	58.00	52.05	86.40	86.50
Fe_2O_3	0.93	1.82	1.35	1.99	0.42	0.20
TiO_2	0.12	0.25	0.22	1.72	0.68	0.41
Na_2O	0.09	0.86	0.51	0.09	1.00	0.45
K_2O	nil	0.05	0.02	3.32	nil	nil
CaO	nil	0.59	0.46	nil	0.78	0.12
MgO	1.83	1.55	1.84	1.33	0.44	2.02
LOI	13.98	6.05	9.62	9.08	2.31	0.26

TABLE IV

PARTICLE SIZE DISTRIBUTION (-325 FRACTION)
SELECTED SAMPLES

	Hole 18 18-21	Hole 18 33-36	Hole W13 9-12	Hole W13 30-33	Hole 1A 12-15	Hole 1A 30-33
% < 20 μ	100	100	99	100	99	100
% < 10 μ	71	82	73	93	80	85
% < 5 μ	55	72	47	89	59	62
% < 2 μ	19	43	19	76	26	19
% < 1 μ	0	13	8	51	7	5
% < 0.5 μ	0	5	4	24	3	0

TABLE V

MINERALOGY - HYDROCYCLONED SAMPLES
MAJOR PHASES

Sample	Kaolin	Quartz	Pyrophyllite
Open Cut #1			
+100	62	35	3
Underflow (-100)	80	14	6
Overflow (-100)	92	6	2
Open Cut #2			
+100	56	40	4
Underflow (-100)	86	8	6
Overflow (-100)	90	2	2

MEG:ls

INTER-OFFICE MEMORANDUM 194

TO J. C. Hicks (2) - 1041 KC
XX Jan Bowman - Port Kembla
R. P. Stice - 1015 KC
H. Fleshman - 1077 KC

COPIES TO S-23

RF, WR

DATE May 20, 1968

FROM F. F. Raine F. F. Raine
AT Mexico

SUBJECT IL-68-F610
Australian Kaolin

The Mt. Crawford Kaolin is of the kaolin type which cannot be dimensionally stabalized at 2500°F to 2600°F and a calcination temperature of 2900°F to 3000°F would be required to make a dense, stable calcine to be used as an aggregate for specialty products or brick. Linear Shrinkage of 20-22% precludes the use of this clay as a bond clay in brick or specialty products.

The Birdwood clay apparently is a mixture of kaolin and some non-clay mineral. Linear shrinkage is at a maximum at 2910°F.

The shrinkage of 14.4% at 2910°F precludes the use of this clay as a bond in brick or specialty products. A useful calcine could be made of the Birdwood clay only by a calcination at 2910°F or above.

FFR/dp
5/21/68

INTER-OFFICE MEMORANDUM

TO J. C. Hicks (2) - 1041 KC
AT Jan Bowman - Port Kembla
R. P. Stice - 1015 KC
H. Fleshman - 1077 KC

COPIES TO
S-23, RF, WR

DATE May 20, 1968

FROM Gerd Schroth G.S.
AT Mexico

SUBJECT IL-68-F610
Australian Kaolin

ABSTRACT

Two clays from Australia have been evaluated. The Mt. Crawford clay has a PCE cone 33 (1743°C, 3169°F) and a maximum linear shrinkage of 22.4%. The PCE cone of the Birdwood clay is approximately 32-33 (1717°C - 1743°C, 3123°F - 3169°F) and its maximum linear change is 14.4%.

PROCEDURE

Jim Hicks submitted two Australian clay samples from the area near Adelaide to the Technical Center for evaluation.

Besides a PCE cone test (ASTM C-24) on the Mt. Crawford clay, cylinders have been formed and fired at various temperatures for five (5) hours. As soon as our PCE furnace is repaired, the exact PCE cone of the Birdwood clay will be determined.

RESULTS

The Mt. Crawford clay is more plastic than the Birdwood clay. The Mt. Crawford clay becomes volume-stable at about 3000°F (1650°C) and the Birdwood clay at 2910°F (1600°C).

Because of the high temperature which would be required to calcine these clays for getting a volume-stable aggregate it seems questionable whether they could be used for the manufacture of Purocast and/or Hi-Strength. For numerical results see attached table.

GS/dp
5/21/68
Ck'd FFR

IL-68-F610
Australian Kaolin

May 20, 1968
Page 2

Clay	Temp. °F	Lin. Change %	Vol. Change %	Porosity %	Absorp. %	Bulk Den. g/cm^3	Apparent Density g/cm^3
Mt. Crawford	1800	2.4	8.5	55.9	46.9	1.19	2.70
	2000	4.0	14.5	55.9	46.0	1.21	2.75
	2200	8.8	17.2	45.7	30.7	1.49	2.75
	2550	14.4	39.8	35.1	19.4	1.81	2.78
	2732	17.6	47.3	26.8	13.3	2.02	2.76
	2910	20.0	51.5	5.0	2.1	2.39	2.52
	3000	22.4	57.2	2.6	1.1	2.42	2.50
(Cone 32)	3132	22.4	57.2	2.5	1.1	2.35	2.41
Birdwood	2000	0.4	2.5	45.5	30.9	1.28	2.69
	2550	1.6	6.5	41.2	26.0	1.58	2.69
	2732	2.4	8.0	40.5	25.9	1.56	2.62
	2910	14.4	40.1	1.3	0.6	2.25	2.28
	3000	12.0	34.8	0	0	2.28	2.28
(Cone 32)	3132	12.0	33.0	5.4	2.6	2.09	2.21

KAISER REFRACTORIES
INTER-OFFICE MEMORANDUM

S. O. Shopher
H. G. Fleshman

Date May 8, 1968

From R. E. Farris
At Milpitas

Subject Australian Clay, Mt. Crawford Deposit Project 607-157T

Copies To J. C. Hicks
J. F. Knight
M. L. Van Dreser

ABSTRACT: The mineralogy, chemistry, and particle size distribution of the Mt. Crawford clay is presented together with typical data from Georgia Kaolin and Edgar Plastic Kaolin for comparative purposes.

INTRODUCTION:

Clay samples from the Mt. Crawford area in Australia were obtained from The Readymix Group (S.A.), by H. G. Fleshman and forwarded to the Milpitas lab for analysis. The natural deposit of clay consists essentially of equal portions of quartz and kaolin, the quartz being separable by a screening and washing technique in the laboratory. It is anticipated that the silica (quartz) portion of the deposit can be used for glass sand in glass making industries, and the kaolin can be used for refractories as well as for possible filler applications, paper coating, etc. The titania (TiO_2) and iron (as Fe_2O_3) content of kaolins has some bearing on their usefulness in the paint and paper coating industry, as well as in the refractories industry. The particle size distribution is also critical, as well as the size and shape of the particles.

The comparative brightness of the particles is a critical factor in determining the usefulness of kaolin in the paper and paint industry and is related to the TiO_2 content but we do not have the necessary equipment to determine brightness.

The results of our tests are tabulated in the attached tables and may be summarized as follows:

Sample Preparation:

A raw clay sample was blunged 24 hours using Darvan C as a deflocculant. The deflocculated slurry was washed through a Tyler standard screen set consisting of the following screens: 28 mesh, 35 mesh, 48 mesh, 65 mesh, 100 mesh, 150 mesh, 200 mesh, and 325 mesh. The plus 325 mesh portion was considered to be quartz sand and the minus 325 mesh was considered to be kaolin. The size distributions of these materials are tabulated in Table I. An M.S.A. Whitby particle size distribution was made on the minus 325 mesh portion and is shown in Figure 1.

Particle Size Distribution:

Approximately 93% of the coarse quartz fraction lies above 150 mesh and below 28 mesh. Sixty-six (66) per cent of the quartz is coarser than 65 mesh. This material should be an ideal glass sand if the kaolin can be efficiently removed.

The minus 325 mesh fraction (Kaolin) is 96% $<20\mu$ with 50 wt. % lying below 3μ. This distribution compares favorably with commercially available processed kaolins. Comparisons are shown on Figure 1.

Chemical Analysis:

The chemistry of the clay portion of the Mt. Crawford clay has one apparent advantage over the higher purity domestic kaolins. This advantage is the lower TiO_2 content. Analysis of various washed fractions (see Table II) indicate that the TiO_2 is present as a separate mineral phase and is predominantly in the +325 mesh fraction. Domestic kaolins apparently have Ti^{+3} or $^{+4}$ substitutions in the kaolinite lattice structure and are impossible to remove below certain fixed values. The data also indicate the Na_2O portion is soluble and MgO is probably present as a mineral phase (most probably talc) and is separable. These data indicate that minimum washing results in fairly good separation of clay and quartz. Modern refining processes should do an excellent job of separation.

Mineralogy*:

Table III is a listing of mineral phases and their relative percentages as determined by XRD and petrographic techniques. The mineral species detected were consistent with chemical analysis. Better washing and separating processes should change the balance of residual quartz in the clay and residual clay in the quartz. Proper calcining procedures can alter the rutile to anatase resulting in greater whiteness and higher surface area resulting from the morphology of the anatase (low temperature form of rutile).

* Memos from W. H. Boyer dated 4/13/68, "Australian Clay", Project 607-157T.

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May 8, 1968

TABLE I

PARTICLE SIZE DISTRIBUTION OF RAW MT. CRAWFORD CLAY

Screen Size (Tyler)	Per Cent Retained		Calculated Analysis of +325 Mesh (Quartz)		
28	0.50		0.95		
35	7.00		14.50		
48	15.40		29.60		
65	10.60		21.00	66%	
100	9.70		18.60		
150	4.80		9.25		93%
200	2.10		4.04		
325	1.60	52.3%	3.08		
-325	47.7 --(most probably Kaolin)				

TABLE II

CHEMICAL ANALYSIS OF MT. CRAWFORD CLAY

	Raw Clay R.M.Co.[1] Anal.	Raw Clay Sample, Washed +325 Mesh Portion Mil.[2] Data	Washed Clay Sample From RMG, Washed -200 Mesh Portion RMG Ana.	Washed Clay Sample From RMG, Washed -200 Mesh Portion Mil. Ana.	Raw Clay Spl. Washed-Mil. -325 Portion	E.P.K.[3] Kaolin (Tech. Data)	G.K.[4] "Pioneer" (Tech. Data)
Al_2O_3	14.70	1.55	37.00	35.96	36.88	38.71	38.51
SiO_2	75.80	96.17	47.80	48.15	46.89	45.91	45.68
Fe_2O_3	0.34	0.09	0.42	0.42	0.44	0.42	0.44
TiO_2	0.32	0.57	0.08	0.10	0.11	0.34	1.43
Na_2O	0.62	0.04	0.21	0.12	0.10	0.04	0.04
K_2O	0.01	0.02	0.01	0.03	0.03	0.22	0.14
CaO	0.01	0.10	0.02	0.12	0.11	0.09	0.24
MgO	0.80	0.43	0.74	0.63	0.35	0.12	0.14
LOI	6.55	0.83	13.50	14.50	15.03	14.15	13.51

1 - R.M.G. = Ready Mix Group
2 - Mil. = Milpitas
3 - E.P.K. = Edgar Plastic Kaolin
4 - G.K. = Georgia Kaolin

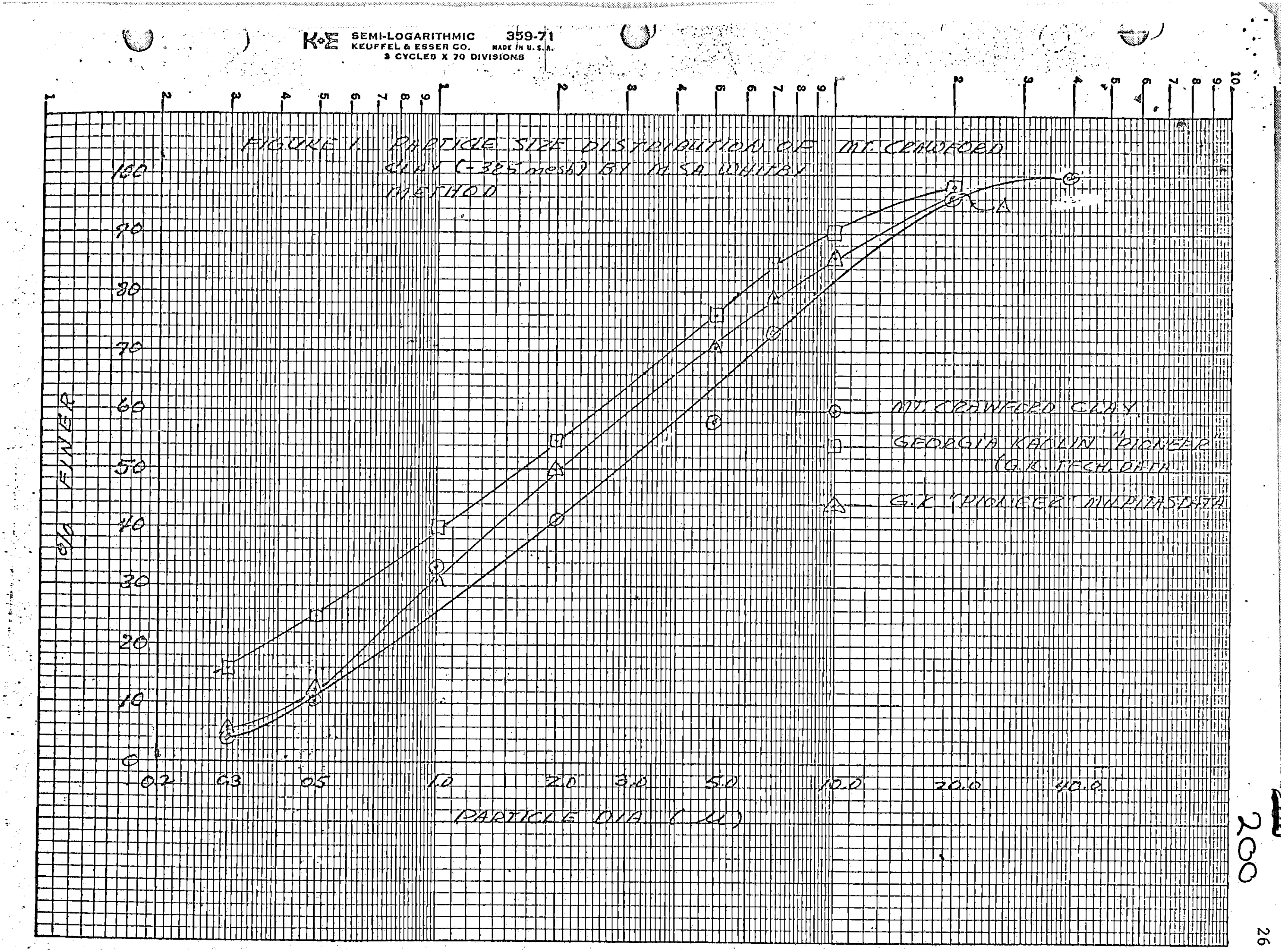
TABLE III

MINERALOGY OF MT. CRAWFORD CLAY SAMPLE*

	Clay Sample Washed and Separated into Two Fractions: +325 Mesh (Quartz)	Clay Sample Washed and Separated into Two Fractions: -325 Mesh (Kaolin)
Kaolinite	~ 4%	~ 94%
Quartz (SiO_2)	~ 94	~ 5
Talc	~ 2	~ 1
Rutile (TiO_2)	~ 1/2	Trace

* From W. R. Boyer's memos, 4/13/68, "Australian Clay", Project 607-157T.

REF:es


K+E SEMI-LOGARITHMIC 359-71
KEUFFEL & ESSER CO. MADE IN U.S.A.
3 CYCLES X 70 DIVISIONS
FIGURE 1. PARTICLE SIZE DISTRIBUTION OF MT. CRAWFORD CLAY (-325 mesh) BY M.S.A. WHITBY METHOD
% FINER
PARTICLE DIA (μ)
MT. CRAWFORD CLAY
GEORGIA KAOLIN "PIONEER" (G.K. TECH. DATA)
G.K. "PIONEER" MILPITAS DATA
0.2
0.3
0.5
1.0
2.0
3.0
5.0
10.0
20.0
40.0
0
10
20
30
40
50
60
70
80
90
100

200

EHV 1082 AWH

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RECEIVED 11 FEB 1970 DEPT. OF MINES REGISTRY

INTER-OFFICE MEMORANDUM

RECEIVED - 8 DEC 1969

To S. D. Shopher
At 1041 KC

Date November 17, 1969

From T. F. O'Neill
At 710 KC

Copies to J. P. Davies - 731 KC
J. F. Knight - 2238 KC
W. MacGregor - 2258 KC
E. L. Vickers - 741 KC

Subject Mt. Crawford kaolin, South Australia.

bcc: A. L. Chave, Ready Mix Concrete Ltd. SYDNEY AUST.

REPORT No 3

The Mt. Crawford kaolin deposit, located 40 miles north of Adelaide, South Australia, and owned by Australian Blue Metal Ltd., was examined during my recent trip to Australia. The situation is briefly as follows.

Geology: The white clay deposits are the result of weathering of a fine grained quartz-biotite gneiss whose foliation, and original sedimentary bedding, dips very steeply. The clay deposits tend to occur on the higher surfaces of ridges, spurs, and isolated low hills within the property. Some of the weathering undoubtedly dates back 15-20 million years to a mid-Tertiary erosion surface which is partially preserved, but much of the clay is the result of more recent weathering.

Brown, buff, cream, and white residual clay deposits cover most of the higher surfaces, and rock outcrops are relatively few. Erosion of these weathered products and deposition in the adjacent valleys has formed extensive deposits of light to dark gray sedimentary clays, but these are of no immediate interest. The potentially valuable clays consist of those portions of the residual clays which are white, or possibly cream colored, in contrast to the surrounding buff to brown residual clays. The thickest and most continuous residual clay deposits result from the combination of favorable topography and favorable, feldspar-rich, permeable gneiss. The white clay portions of these residual clay deposits are the result of intense weathering, which probably was widespread, and their failure to be subsequently stained by the iron oxide which was sporadically introduced into permeable zones by subsequent continuing weathering processes.

The white residual "clays" are normally overlain by 1 to 6 feet of dark brown clayey sand and soil, but occasionally they may be covered by 10 to 15 feet of cream, buff, or brown clayey sand. The "clays" bottom either on hard weathered gneiss or on cream, buff, or brown clayey sand. They are sporadically discolored by iron staining extending outward from joints, by iron staining extending downward as irregular tongues from the surface, or as irregular projections upward into the white "clay" from below.

The white "clay" ranges up to 50 or more feet thick, but averages about 15 feet. Overburden can range up to 25 feet but will average about 5 feet.

Clay composition: The residual white "clay" is actually a white clayey sand. Milpitas made size separations on continuous sample suites from 19 drill holes which showed that the minus 44 micron fraction in

16 of the holes ranged from 35 to 55% by weight and averaged 41%, while three of the holes ranged from 17 to 23% minus 44 micron material and averaged 19%. All were theoretically white "clay". All of these holes were located in the best known clay and they probably represent slightly better than average grade material. Probably the average content of minus 44 micron material in non-selectively mined white "clay" will be in the 30-35% range, although by using this criterion to guide mining the minus 44 micron material could probably be increased to 40-45% in plant feed with a sacrifice in "clay" reserves.

The minus 44 micron material studied by Milpitas consisted of 70-95% kaolinite, trace to 30% pyrophyllite, trace to 10% quartz, and trace to 30% feldspar. Clearly, not all drill holes which disclose white "clay" megascopically have discovered necessarily a useable plant feed for making a paper-grade clay product.

ilpitas
Kaiser
ractories
formerly
U.S. A)

Milpitas further sized seven of the minus 44 micron fractions and found that, excluding one highly atypical sample, the minus 2 micron fraction ranged from 19 to 43% of the 44 micron fraction. Much of the kaolinite is therefore coarse, is not clay size, and presumably is present in the form of "stacks", as the industry terms it. This is corroborated by a binocular examination of numerous field samples, which showed that the kaolinite is unusually coarse, silky, and lustrous, and that it resembles talc or sericite much more than normal kaolinite.

The plus 44 micron fraction in selected white "clay" is primarily quartz. It also contains 1% or less heavy minerals, most of which probably is rutile and which should be recoverable.

Product quality: Milpitas has not examined the minus 44 micron material in detail to determine which quality of coating clay, if any, can be made from this material, nor has the Paper Research Institute at Appleton, Wisconsin, yet examined any of these samples. Milpitas has determined, however, that the brightness of selected samples is very encouragingly high, and that the grain size distribution of the minus 44 micron fraction closely resembles raw Georgia kaolins from which coating clays are made.

Refractories' research personnel are quite confident, however, that that portion of the Mt. Crawford clay represented by most of the samples submitted to them will produce an acceptable coating clay. This fact remains to be established, however. It also remains to be determined, however, what fraction of the white "clay" reserves can produce a coating grade clay.

Reserves: At least 239 drill holes, aggregating 7,395 feet, have been drilled on the property, together with 17 trenches. Only a few of these samples have been analyzed, and probably only a relatively small percentage of the analyses and tests made by others are available to us. However, on the basis of the available results and my geologic interpretation the total reserves of white clayey sand are estimated to be as follows:

Area	Average Thickness, Feet	Short Dry tons
MEASURED CATAGORY		
I	17.0	1,490,000
INDICATED CATAGORY		
II	15.1	1,100,000
III	16.0	350,000
IV	11.7	2,250,000
V	15.0 (estimated)	850,000
Sub-total:		4,550,000
INFERRED CATAGORY		
VI	15.0 (estimated)	1,500,000
VII	15.0 (estimated)	5,000,000
Sub-total:		6,500,000
TOTAL:		12,540,000

These figures are intended to indicate all the white clayey sand which we could reasonably hope to find on the property, and which would be at least 5 feet thick and would have a stripping ratio not to exceed 2:1. It almost certainly unavoidably includes material which has too high a feldspar/quartz content in the fine size ranges.

If we use the assumed production figures presented in the April, 1969, feasibility study the raw material useage and reserve life might be as follows, assuming that the feed averages 35% minus 44 micron material and that 90% of the minus 44 micron is recovered as a kaolin product.

Year	Short tons kaolin product	Short tons "clay" plant feed	Year end "clay" reserve
0	-	-	4,250,000
1	35,000	111,000	4,139,000
2	50,000	159,000	3,980,000
3	70,000	222,000	3,758,000
4	90,000	286,000	3,472,000
5	110,000	349,000	3,123,000
6	130,000	413,000	2,710,000
7	130,000	413,000	2,297,000
8			1,884,000
9			1,471,000
10			1,058,000
11			645,000
12			232,000

Mining: Most of the white clayey sand could possibly be mined by scrapers, but since much of the material is moderately hard, and some is too hard to be broken by a backhoe or a D-8 with a ripper, some other mining scheme should be used. The erratic and widespread iron staining almost dictates that a very selective mining method be used. At the moment it appears that a dragline, operating from the top of the bank, could mine very selectively and satisfactorily. Some unusually hard areas, such as in Area V, probably will require drilling and blasting. Such areas may be uneconomic to mine.

J. P. Davies' operating and capital cost estimate for your assumed mining operation are presented in his memo, a copy of which is attached.

Conclusions: The Mt. Crawford clay property is an attractive prospect which has been over-explored but whose raw material has yet been inadequately tested.

The deposit could contain 4 to 4.5 million short dry tons of minus 44 micron kaolinite-quartz-pyrophyllite-feldspar mixture from at least the better part of which Refractories' research personnel are quite confident that a coating grade clay can be prepared.

Despite an unusually large amount of drilling relatively little, other than generalities, is known about the total raw material. Laboratory testing has lagged far behind exploration.

Very selective mining will be both necessary and possible. Mining costs should approximate US$0.51 per short ton of white "clay" delivered to the plant, including clearing and stripping.

The total potential "clay" reserves on the property could be adequate to support your proposed plant at its desired level of operation for ten to perhaps twelve years. Stringent raw material specifications imposed by the plant could effectively reduce these potential reserves.

Despite the expenditure of about A$150,000 on the property it remains only a prospect.

Recommendations: If you can tolerate the A$80,000 payment required upon signing of the contract, the Mt. Crawford clay deposit warrants thorough examination as a prospect which is apparently capable of producing a coating clay from some of its material. The potential reserves are moderately large and the property is so well located that the laboratory tests and exploration are probably justified.

The program of investigation should be in two phases, as follows:

Phase I: Examine in adequate detail in the laboratory the white "clay" intersections in the ten existing core drill holes in ore. The core has been preserved unsampled, and this material constitutes a reliable suite of ten or more samples which can be used to establish most of the range in product quality available to us. Laboratory testing would be done both by KACC personnel as well as by the Paper Research Institute.

Phase II: If the results of Phase I are encouraging we should then begin a systematic exploration and testing program designed to prove the existence in adequate quantity of the specific raw material required to produce the clay product or products selected as objectives during Phase I.

TFO:ec

Attch.

DN

INTER-OFFICE MEMORANDUM

TO T. F. O'Neill
AT 710 KC

DATE November 17, 1969

FROM J. P. Davies
AT 731 KC

COPIES TO E. L. Vickers - 741 KC

SUBJECT MT. CRAWFORD, SOUTH AUSTRALIA
Sand - Kaolin
Mining

A preliminary feasibility report by H. G. Fleshman contemplated the construction of a slurry preparation and degritting plant to produce water-washed kaolin. It was to be designed so that subsequent additions could be made for production of calcined kaolin and silica. His production schedule was as follows.

	MINE PRODUCTION (1)			PRODUCT			
					KAOLIN (3)		
YR.	TPY	TPD (250 DPY) SINGLE SHIFT	TPH	SAND (2)	RAW (4)	CALC (5)	TOTAL (RAW BASIS)
1	136,000	544	68	71,000	35,000	15,000 (20M)	55,000
2	202,000	816	102	106,500	52,500	22,500 (30M)	82,500
3	272,000	1,088	136	142,000	70,000	30,000 (40M)	110,000
4	408,000	1,632	204	213,000	105,000	45,000 (60M)	165,000
5	544,000	2,176	272	284,000	140,000	60,000 (80M)	220,000

(1) Deposit mine run 55% sand, 45% kaolin

(2) 95% sand recovery

(3) 90% kaolin recovery

(4) 70% of kaolin product sold as raw, water-washed material (dry, spray-dried, or slurry)

(5) 30% of kaolin market sold as calcined product.
L.O.I. + Dust loss = 15% + 10% = 25%

NOTE: All tons expressed as long tons (2240 lbs/ton)

A second feasibility study - Part II - dated April, 1969, sets out the following sales schedule.

First year	-	35,000	short tons water-washed kaolin
Second year	-	50,000	" " " " "
Third year	-	70,000	" " " " "
Fourth year	-	90,000	" " " " "
Fifth year	-	110,000	" " " " "
Sixth year	-	130,000	" " " " "

This schedule corresponds fairly well with that for raw kaolin set out by Fleshman. It is assumed therefore that the washing plants are the same, and that the option to add a kaolin calcining section is considered desirable and has been retained. With this in mind, mining equipment will be sized to deliver crude ore containing 140,000 l.t. of recoverable kaolin on a two-shift basis. Then, when the calcination plant is added, the mine would simply operate on three shifts in order to supply the additional crude ore.

For 140,000 l.t. kaolin, at 90% recovery in processing and 45% kaolin in the crude ore (Note 1), we would require 382,000 s.t. of crude ore. Furthermore, it is expected that one-sixth of the material excavated will have to be cast aside, due to its ferrugineous or lateritic nature. Thus, when the full quota of water-washed kaolin is being produced - 140,000 l.t. - there will be mined each year 458,000 s.t. of crude ore.

It is considered that portions of the ore body may prove too hard for mining by carryall scrapers, and that there will, in fact, be some drilling and shooting. Also, there will be periods during the rainy season when scrapers would not be able to operate effectively. Kaolin is notably slippery in the wet.

The best mining tool under these conditions is considered to be a conventional dragline (Note 2), and a diesel-powered Bucyrus-Erie-type 71-B, with a 2½ cu.yd. bucket, would handle the required tonnage.

<u>Notes:</u> 1. Mine operating costs are based on a kaolin grade in crude ore of 45%. Most recent examinations by T.F.O'Neill indicate that the grade may be substantially less, at 40%, or even 35% kaolin. If ore grade is lower than 45%, then proportionaly more ore will have to be mined, and mine operating costs will be proportionately increased.

Additional mining equipment will not be needed, and capital costs will remain unchanged.

Notes: (continued)

2. An operation such as this, scheduled to start on a rather small scale, with an escalating production rate each year, is best developed in early years by contractor. This relieves the owner of the imposition of a heavy capital expenditure prior to startup, and also gives him the opportunity to assess the nature of the ground and the operating conditions, so as ultimately to introduce the most effective and economical mining equipment.

   It is very possible at Mt. Crawford that ore reserves may be expanded to such a point that it will never be necessary to mine the harder material. Or it may be that difficulties in processing will render this harder material uneconomic. Either circumstance would serve to eliminate drilling and blasting, with attendant savings in capital and operating costs, and may even render mining by scraper practical.

458,000	s.t. crude ore per year
250	operating days per year
1,840	s.t. per operating day
920	s.t. per shift
130	s.t. per operating hour, at
50	swings per hour
2.6 s.t.	per swing are required
a 2½	cu.yd. capacity bucket, at
80	percent load factor, holds
2.0	loose cu. yds., ot
1-1/3	bank cu. yds. or
2.6 s.t.	at 14 cu.ft. per s.t.

Haulage would be by conventional rear-dump truck, and on this scale of operation a Euclid 22 s.t. capacity machine would be ideal. Operating on a 16-minute cycle, with 8 minutes for loading and 8 minutes available for hauling, dumping and returning, two trucks would be required.

Overburden thickness averages about 5 feet over the area to be mined, and at full production rate approximately 2000 square feet will be cleared each day. a CAT D6C, with dozer blade and single tooth ripper, will accomplish this, operating on a single shift basis.

It is anticipated that some drilling and blasting will be necessary in harder material, and in calculating operating costs it has been assumed that 20 percent of ore material will be shot. A Gardner Denver air-track mounted PR 123 drill has been provided in the capital estimate, together with a 600 c/m diesel-powered rotary air compressor. A trailer-mounted auger drill will be used for sample drilling where necessary, together with a half-ton pick-up truck, which will also be used for service functions.

Drainage will generally be by gravity, but a portable, gasoline-powered pump will be provided.

SUMMARY

Capital Cost for Open Cast Mining (in $ US)

Preproduction	Ground clearing		
	Drainage		
	Access Roads		
	Overburden removal		
	Subtotal		$ 40,000
Mining Equipment	Dragline. B.E. 71-B	175,000	
	Euclid 22 t. dumpers x 2	90,000	
	Dozer. CAT D6C	50,000	
	Drill. G.D. PR-123	25,000	
	Compressor. G.D. 600 c/m	23,000	
	Auger drill	5,000	
	Pick-up truck	3,000	
	Pump	1,200	
	Small tools, etc.	2,000	
			374,200
	Freight, taxes, handling - 20%		74,800
	Subtotal		459,000
Buildings	Shop and tools		10,000
	TOTAL		$ 509,000

Operating Costs for Open Pit Mining (in $US)

for full production rate of 458,000 tons crude ore/year

B.71. 2½ yd. dragline	14 hrs x 250 x $18	63,000	
22 t. rear dump trucks	2 x 14 x 250 x $12	84,000	
D6C. bulldozer	7 x 250 x $12	21,000	
GD. PR 123 percussion drill	35,700 ft at 20¢	7,100	
GD. 600 c/m air compressor	7 x 125 x $ 6	5,200	
Powder and caps		12,000	
Auger drilling	7 x 125 x $ 6	5,200	
Miscellaneous services		2,500	
	Subtotal		$ 200,000

Manpower and wages

Dragline operators x 2		7,820	
Truck drivers x 4		15,640	
Dozer operators x 1		3,910	
Driller x 1		3,910	
Utility man x 2		5,040	
	Subtotal		36,320
	TOTAL		$ 236,320

Proration for years 1 through 6

	Sales	Mining Op. Costs
Year 1	35,000	64,000
" 2	50,000	91,000
" 3	70,000	128,000
" 4	90,000	164,000
" 5	110,000	200,000
" 6	130,000	236,000

(Placer } = joint
+ Kaiser } venture
in Aust.)

PLACER PROSPECTING (AUSTRALIA) PTY. LTD.
A subsidiary of Placer Exploration Ltd. INC. IN A.C.T.
GOLD FIELDS HOUSE, SYDNEY COVE, N.S.W. TELEPHONES: 27-1773-4-5 TELEX: 21356
POSTAL ADDRESS: G.P.O. BOX 4315, SYDNEY 2001, N.S.W., AUSTRALIA—CABLES: PLACER

29th April, 1969.

Mr. A. W. Hardwicke,
Regional General Manager,
Ready-Mix Group, S.A.,
No. 82 East Terrace,
ADELAIDE. S.A. 5000.

MT. CRAWFORD.
KAOLIN - SILICA SAND - RUTILE. *

Dear Mr. Hardwicke,

When Garth Wilson, of Placer, handed me the Mt. Crawford clay/sand topographic sheets today, that Peter Taylor had sent over by him, I realized I had been remiss in acknowledging and thanking you both for a very pleasant visit last month. It was not only professionally rewarding (for I saw and learned several things about this type of deposit that were new to me), but meeting you both was a distinct pleasure.

* || I summarized my reactions to -- what to me -- appeared to be a very fine deposit in a memorandum, a copy of which went to the Kaiser Refractories Division here in Australia.

However, it is my understanding that the Kaiser Refractories people will make the final decision, together with yourselves, and that Placer personnel will not be involved further unless called upon.

In the meantime, let me again express my appreciation for your hospitable treatment of Ted Arthur and self while in Adelaide. Thank Peter also and I trust we will see you both again.

Sincerely yours,

Tom Murphy

T.D. MURPHY.
Consultant.
(to Kaiser Co. U.S.A)

c.c.: Mr. E. B. Bell.
TDM.CP.69/639.

ENV 1082 213 S. D. SHOPHER

NOV 25 1969

REFRACTORIES DIV.

DN

INTER-OFFICE MEMORANDUM

TO S. D. Shopher
AT 1041 KC

DATE November 24, 1969

FROM T. F. O'Neill
AT 710 KC

CHIEF GEOLOGIST KAISER Co. U.S.A.

COPIES TO J. F. Knight - 2238 KC
W. Macgregor - 2258 KC
E. L. Vickers - 741 KC

bcc: A. L. Chave, Ready Mix Concrete

SUBJECT Mt. Crawford clay; South Australia.

REPORT No 3

In order to make the Mt. Crawford clay opportunity a little clearer I have up-dated your Case 1 and Case 2 financial evaluations which were part of your April, 1969, Feasibility Study, Part II. I have followed the same procedures you used in your evaluations with the following exceptions:

1. The maximum life of the raw material source is 12 years, and it could be as short as 10 or even 8 years, particularly if an unusually high quality product must be produced in order to make the property economically attractive.

2. The capital investment has been increased to \$3,060,000 to include the increased cost of mining equipment as estimated by Davies.

3. The cost of goods has been increased to include the higher mining costs as estimated by Davies.

4. Depreciation schedules for mining operations are very flexible in Australia, and I have arbitrarily used straight line depreciation over an 8-year life for all cases.

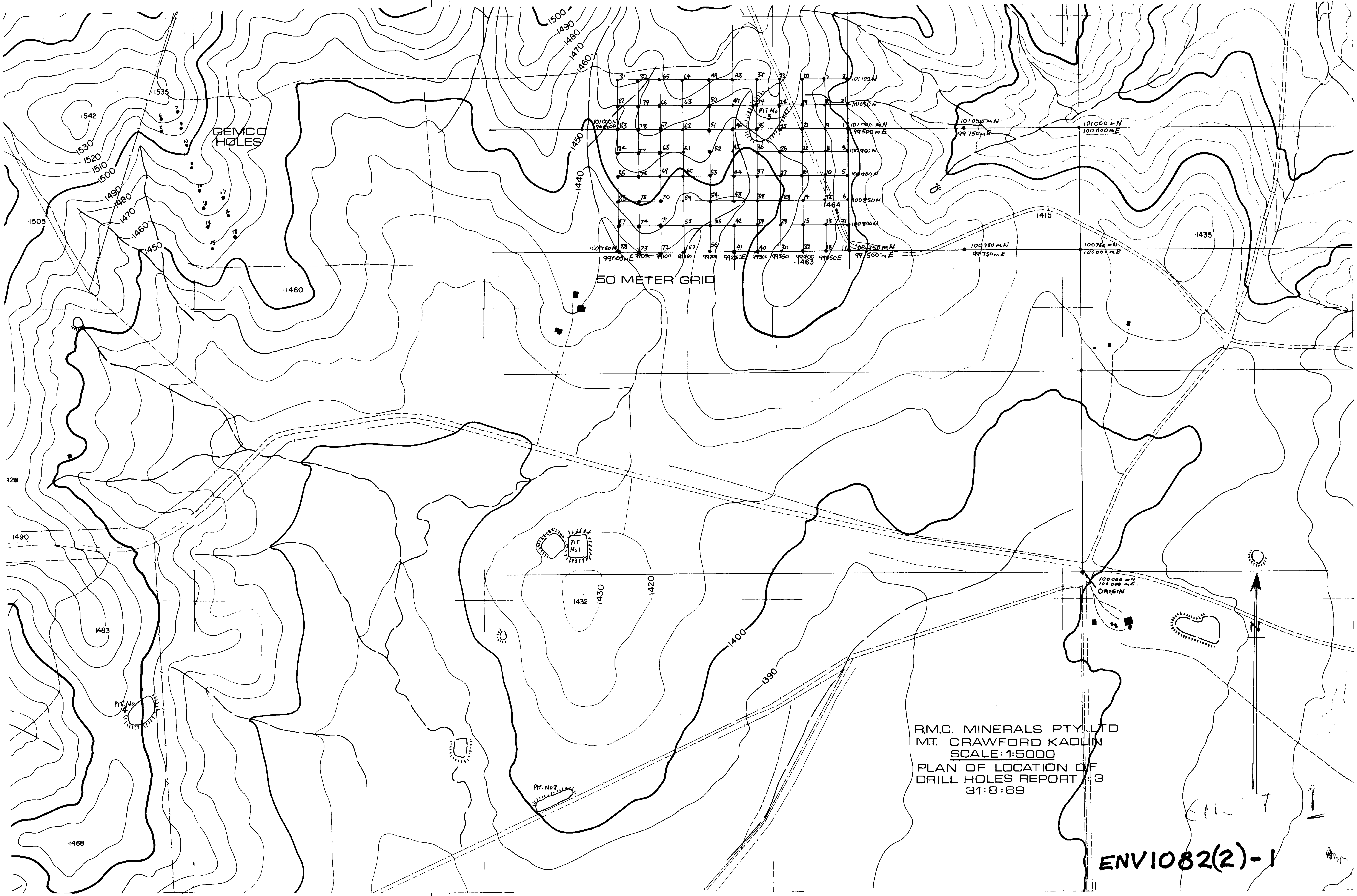
5. Only that portion of depreciation actually earned before taxes was included in cash flow.

Based on these assumptions the ROI has been calculated for a mine life of 8, 10, and 12 years for your Case 1 (an average washed kaolin selling price equal to that of No. 2 coating grade kaolin) and your Case 2 (an average washed kaolin selling price equal to that of No. 1 coating grade kaolin). The results are as follows:

	Return on investment	
Mine Life	Case 1	Case 2
8 years	9.0%	20.8%
10 years	12.4%	24.5%
12 years	14.0%	26.3%
Payout	6.3 yrs.	4.7 yrs.

RECEIVED 11 FEB 1970 DEPT. OF MINES REGISTRY

We have not contacted A. L. Chave since Vickers and I returned from Australia, and he should be given an answer very shortly as to whether we are going to sign the contract for his property. If you will let me know whether the Mt. Crawford deposit, as we visualize it, can or cannot meet the requirements of the Refractories Division I can give Chave the appropriate answer.


GEMCO HOLES
50 METER GRID
PIT No 3
PIT No 1.
PIT No 2
PIT No 4
100 000 mN
100 000 mE
ORIGIN
N
R.M.C. MINERALS PTY. LTD
MT. CRAWFORD KAOLIN
SCALE: 1:5000
PLAN OF LOCATION OF
DRILL HOLES REPORT : 3
31:8:69
ENV1082(2)-1

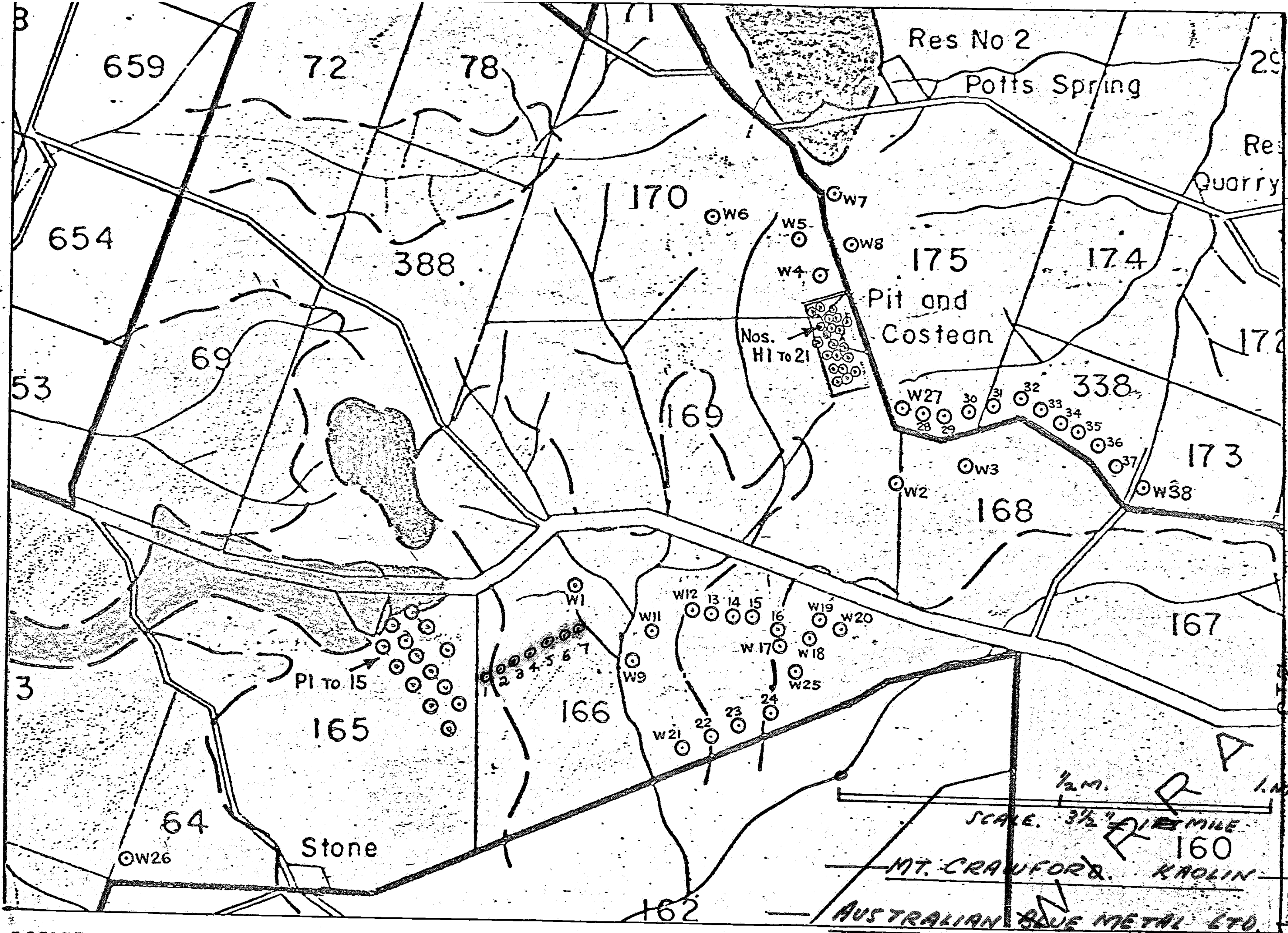
ENV 1082/1

214

Drillers Log "Mt. Crawford"

Drilled early February, 1970.

Hole No.	Depth	Remarks
1.	0 - 27	Brown and white sand, stones at 27'0" and water.
2.	0 - 33	Brownish sand, patch of stones or rock
3.	0 - 3	Top soil Grey sand with quartz and band of hard country rock
4.	0 - 3 6 - 21	Top soil Brown dirty sand and pebble conglomerate Yellow sand
5.	0 - 3 3 - 6 6 -9 9 - 13	Top soil Red brown sand together with pebbles Yellow sand Grey sand, hard quartzite layer
6.	0 - 3 3 - 6 6 - 12 12 - 21	Top soil Light grey sandy clay Red brown sandy clay Brown sand and stones
7.	0 - 3 3 - 30	Top soil Yellow brown sand and stones



LOCATION OF DRILL HOLES - S.M.L. 174   HOLES SHOWN THUS ⊙

FEB 1970 (MARKED IN RED)

ENU 1082/11

THE READYMIX GROUP CHEMICAL TESTING LABORATORY

In reply to request of 11.7.69 (see Mn. 27/68) to provide basis of fractionation

STANDARD ANALYTICAL METHOD

RECEIVED 27 AUG 1969 DEPT. OF MINES

Test Ref. No. None Readymix C.T.L. Mt. Cr. 01 (S. Isldvig)

Rapid Determination of the Sand and Clay Fractions of Kaolinised Sandstone.

01 Preparation

01-1 Obtain a representative sample (150 grm. approx) from the received drill-hole samples.

01-2 Make a moisture determination using 10 grm. of the obtained representative sample. Report the calculated moisture factor (M.F.) to three decimal places (e.g. 1.167)

$$M.F. = \frac{\text{Weight of material before drying}}{\text{Weight of dried material } (105^{o}C)}$$

01-3 Crush sample with a hard rubber mallet on a hardwood board. Pass through a sieve with openings of nominal aperture about 2 m/m (B.S.S. No. 8 or A.S.T.M. No. 10)

01-4 Weigh 100 grm of the sample obtained in 01-3 and disperse it in water using a Semac Vitamizer for 60 secs.

01-5 Screen through a 350 mesh B.S.S. sieve and dry the plus fraction to constant weight.

02 Calculations

02-1 Calculate the percentage of sand fraction

$$\frac{Ws}{M.F.} = S.F. \quad \text{(per cent)}$$

where;

Ws = Weight of the dried sand fraction

M.F.= Moisture factor

S.F.= Sand fraction.

02-2 Compute the percentage of Clay fraction

$$\frac{(100 - (S.F.)}{M.F.} = C.F. \quad \text{(per cent)}$$

where;

M.F. = Moisture factor

S.F. = Sand fraction

C.F. = Clay fraction

RWH.

ENV 1082/1

AUSTRALIAN BLUE METALS PTY. LTD.

DRILLERS LOG OF HOLES DRILLED BY AUGER EQUIPMENT IN MT. CRAWFORD S.M.L. 174.

50 METRE GRID SURROUNDING PIT NO.

Hole No.	Feet Depth	Remarks
1	0-3	Light Brown Sandy Top Soil Orange Iron Stained Subsoil
	3-6	Buff Sand, Grading into hard Sandstone (Abandoned)
2	0-3	Light Brown Sandy Top Soil, Grading into Buff Sandstone Capping (Abandoned)
3	0-3	Light Brown Sandy Clay Topsoil
	3-6	Grey Clay - then into off/white Kaolinized Sandstone
4	0-3	Red/Brown Clay Top Soil Red Iron Stained Clay Subsoil
	3-6	Red Iron Stained Clay - then into Stained Sand/Stone
5	0-3	Red/Brown Dark Clay Topsoil
	3-9	Red Iron Stained Clay (Abandoned)
6	0-3	Red/Brown Dark Clay Topsoil
	3-6	Pink Iron Stained Talcose Clay (Abandoned)
7	0-3	Light/Brown Sandy Topsoil Brown Clay Subsoil
	3-6	Buff Kaolinized Sandstone
	6-12	White Kaolinized Sandstone
	12-15	Off/White Kaolinized Sandstone
	16-18	Yellow Sandy Clay
	18-24	Buff Clay - Soft
8	0-3	Light/Brown Sandy Clay
	3-6	Light/Brown Clay
	6-24	White Kaolinized Sandstone
	24-27	Buff Kaolinized Sandstone
	27-30	Orange Sand

Hole No.	Feet Depth	Remarks
9	0-3	Brown/Sandy Clay
	3-6	Brown/Cream Clay
	6-9	Cream Kaolin Soft, then into Hard Kaolinized Sandstone
10	0-3	Red/Brown Iron Stained Clay
	3-6	Pink/Buff Sandstone (Abandoned)
11	0-3	Red/Brown Iron Stained Clay$ (Abandoned)
12	0-3	Red/Brown Sandy Clay
	3-6	Pink/Buff Kaolinized Sandstone
	6-21	White Kaolinized Sandstone
	21-36	White/Off White Sandstone
13	0-3	Red/Orange Iron Stained Clay
	3-6	Red/Pink Iron Stained Clay Traces of Kaolin Sandstone
	6-9	Hard Off/White Kaolin Sandstone
14	0-3	Light/Brown Sandy Topsoil Orange Subsoil - Sandy
	3-9	Buff/Yellow Sand
	9-12	Buff Sand
	12-15	Buff Sandstone
15	0-3	Orange/Brown Iron Stained Clay
	3-6	Yellow Sand
	6-9	Grey Sand
	9-12	White Sand
	12-15	Yellow Sandstone

Hole No.	Feet Depth	Remarks
16	0-3	Orange/Brown Iron Stained Clay
	3-6	Khaki coloured Sand
	6-12	Yellow Sand
	12-15	Cream Sandy Kaolin
	15-24	Off/White Sand. Low % of Kaolin
	24-27	Yellow Sand
	27-33	Buff Sand - Grading
	33-36	into Off/White Kaolinized Sandstone
17	0-3	Brown/sandy Clay
	3-6	Brown/Iron Stained Clay
	6-9	Red/Blue Stained Clay
	9-12	Red/Orange Sandy Clay Grading into Hard Yellow Sandstone
18	0-3	Orange Iron Stained Sandy Clay
	3-6	Red/Brown Iron Stained Clay
	6-9	Off/White Kaolinized Sandstone - Hard (Abandoned)
19	0-3	Brown Sandy Clay
	3-6	Buff Kaolinized Sandstone
	6-9	White Kaolinized Sandstone
	9-18	White Kaolinized Sandstone
	18-21	Off White Kaolinized Sandstone
20	0-3	Brown Iron Stained Clay
	3-6	White Sandy Kaolin
	6-21	White Kaolinized Sandstone
	21-33	Off/White Sandstone (% of Kaolin decreasing with depth)

Hole No.	Feet Depth	Remarks
21	0-5	Brown Sandy Topsoil Buff Clay Subsoil traces of Kaolin
	5-7'6"	Buff Sandy Clay
	7'6"-10'	Buff Kaolinized Sandstone
	10'-12'6"	White Kaolinized Sandstone
	12'6"-30'	White Kaolinized Sandstone
	30'-55'	Cream/Buff Kaolinized Sandstone
22	0-10	Buff Sand low % of clay
	10-45'	White Clayey Sand low % of Kaolin
23	0-3	Cream Kaolinized Sandstone
	3-6	Cream Kaolinized Sandstone Hard (Abandoned)
24	0-3	White Kaolinized Sandstone
	3-30	White Kaolinized Sandstone
	30-36	Buff Kaolinized Sandstone
25	0-5	Red Clayey Sand with traces of Kaolinized Sandstone
	5-20	Off White Kaolinized Sandstone
	20-30	Grey Kaolin Sandstone (% of Kaolin increasing)
26	0-5	Brown/Clay traces of Kaolinized Sandstone
	5-25	Cream Kaolin Clay
27	0-6	Off White Sandy Clay
	6-12	White Kaolin - Soft sticky Plastic Clay
	12-36	Brown High Plasticity Clay
28	0-6	Grey/Brown Sandy Clay
	6-9	White Kaolin - Soft
	9-36	Brown "High Plasticity" Clay
29	0-6	Red/Brown Sandy Iron Stained Clay
	6-12	Off/White Kaolin - Soft
	12-36	Off/White/Brown High Plasticity Cla

Hole No.	Feet Depth	Remarks
30	0-6	Brown/Stained Kaolinized Sandstone
	9-12	Off/White Kaolinized Sandstone
	12-15	White Kaolinized Sandstone
	15-24	Brown Stained Kaolinized Sandstone
31	0-2	Drilled-Off Light/Brown Sandy Soil
	2-5	Iron Stained Clay Subsoil
	5-10	Red/Brown Stained Clay last 1" being hard white Sandstone
	10-15	White Kaolinized Sandstone
	15-20	Off/White Kaolin - Soft
	20-35	Kaolinized Sandstone
32	0-3	Orange/Brown Iron Stained Clay
	3-6	Yellow Sand
	6-9	Grey Sand
	9-12	White Sand
	12-15	Yellow Sandstone - To hard
33	0-5	Buff Kaolinized Sandstone
	5-10	Cream Kaolinized Sandstone
	12'6" - 32'6"	White Kaolinized Sandstone (% of Kaolin decreasing with depth)
34	0-3	Iron Stained Kaolinized Sandstone
	3-15	Buff Kaolinized Sandstone
	15-33	White Kaolinized Sandstone
35	0-3	Dark/Brown Top soil Grey Clay Subsoil
	3-6	Yellow/Brown Plastic Clay
	6-27	White Kaolinized Sandstone
	27-30	Grey Kaolinized Sandstone
	30-39	Grey/Buff Kaolinized Sandstone
36	0-6	Light/Brown Plastic Clay
	6-30	Cream/Light/Brown Kaolin High Plasticity Clay

Hole No.	Feet Depth	Remarks
37	0-6	Dark Grey Clay Soil Traces of Kaolinized Sandstone
	6-12	Off/White High Plasticity Clay
	12-18	Light/Brown High Plasticity Clay
38	0-5	Light/Brown Sandy Clay Soil Traces of Kaolin
	5-10	Brown/Yellow Iron Stained Clay Kaolin
	10-12'6"	Buff/Cream Kaolin
	12'6" - 25	Buff High Plasticity Clay
39	0-5	Brown Sandy Clay Soil Off White Clay Subsoil
	5'-7'6"	Grey Kaolinized Sandstone
	7'6"-10'	Off/White Sandstone
	10'-22'6"	Off/White Kaolinized Sandstone
40	0-6	Off/White Kaolin
	6-9	Light Brown High Plasticity Clay
	9-36	Light/Brown High Plasticity Clay
41	0-6	Off/White Kaolinized Sandstone
	6-12	White Talcose Clay
	12-15	Brown Iron Stained Clay
	15-18	Cream Talcose Clay
	18-21	Buff High Plasticity Clay
	21-24	Buff High Plasticity Clay (Plastic)
42	0-3	White Kaolinized Sandstone Capping (Abandoned hard)
43	0-6	Off/White Kaolin
	6-12	Off/White Kaolin
	12-21	White Plastic Kaolin Clay
	21-36	Brown High Plasticity Clay

Hole No.	Feet Depth	Remarks
44	0-3	Brown/Iron Stained Sandy Clay Topsoil
	3-6	White Kaoli nized Sandstone
	6-9	White Kaolinized Sandstone
	9-12	White Kaolinized Sandstone
45	0-6	Brown Iron Stained Kaolinized Sandstone
	6-12	Brown Iron Stained Kaolinized Sandstone (Hard Abandoned)
46	0-6	Off/White Kaolinized Sandstone
	6-12	Off/White Kaolinized Sandstone (Hard Abandoned)
47	0-5	Light/Brown Kaolinized Sandstone
	5-7'6"	Light/Brown Iron Stained Kaolinized Sandstone
	7'6" - 10	Light/Brown Iron Stained Kaolinized Sandstone
	10' - 25	White/Off/White Kaolinized Sandstone
	25' - 27'6"	Buff Kaolinized Sandstone
	27'6"-30	White Kaolinized Sandstone
48	0-3	Light/Brown Iron Stained Kaolinized Sandstone
	36 3-6	Light/Brown Iron Stained Kaolinized Sandstone (Abandoned)
49	0-3	Brown Iron Stained Clay
	3-6	Light/Brown Kaolinized Sandstone (Hard Abandoned)
50	0-3	Brown Iron Stained Kaolinized Sandstone
	3-6	Light Brown Kaolinized Sandstone
	6-54'	White Kaolinized Sandstone

Hole No	Feet Depth	Remarks
51	0-3	Brown Sandy Clay Topsoil
	3-12	White Kaolinized Sandstone
	12-18	Off/White Kaolinized Sandstone (Soft Clay)
	18-21	White Kaolinized Sandstone (Soft Clay)
	21-27	Off/White Kaolinized Sandstone (Soft Clay)
	27-36	Grey Kaolinized Sandstone (Soft Clay)
52	0-3	Orange/Brown Iron Stained Clay
	3-6	Cream Kaolinized Sandstone (Hard Abandoned)
53	0-3	Brown/Sandy Clay
	3-6	Light/Brown Kaolinized Sandstone
	6-39	White Kaolinized Sandstone
	39-42	Buff/Orange Kaolinized Sandstone
	42-48	Buff Kaolinized Sandstone
	48-57	Buff Kaolinized Clay High Plasticity type
54	0-3	Light/Brown Kaolinized Sandstone
	3-6	Off/White Kaolinized Sandstone
	6-9	White Kaolinized Sandstone
	9-12	White Kaolinized Sandstone
	12-18	White Soft Talcose Kaolin Clay
55	0-5	Brown/Clay Top soil White Kaolinized Sandstone
	5 - 7'6"	Off/White Kaolinized Sandstone
	7'6"-10'	Grey Clay
	10'-25	White Soft Talcose Kaolin Clay

Hole No.	Feet Depth	Remarks
56	0-6	Brown/Iron Stained Clay White Kaolin Traces
	6-9	Off/White Kaolinized Sandstone
	9-12	Grey Kaolinized Sandstone
	12-15	Off/White Kaolinized Sandstone
	15-21	Off/White Kaolinized Sandstone
	21-30	Buff High Plasticity Clay
57	0-3	Grey Clay Topsoil
		Off/White Kaolinized Sandstone Capping - Hard
58	0-3	Light Sandy Topsoil Off/White Kaolin Sandstone
	3-6	White Kaolinized Sandstone
	6-24	White Kaolinized Sandstone
	24-27	Buff/Brown Kaolinized Sandstone
	27-30	White Kaolinized Sandstone
59	0-3	Red/Brown Sandy Iron Stained Clay
	3-6	Off/White Kaolinized Sandstone
	6-9	Off/White Kaolinized Sandstone (Abandoned)
60	0-3	Brown Iron Stained Clay
	3-6	Buff Kaolinized Sandstone
	6-9	White Kaolinized Sandstone
	9-42	White Talcose Kaolin
	42-45	Iron Stained Kaolin
	45-54	Buff Plastic Bentonitic type Clay
61	0-3	Light Sandy Top Soil Traces White Kaolinized Sandstone
	3-6	Buff/Off/White Kaolinized Sandstone
	6-33	White Kaolinized Sandstone

Hole No.	Feet Depth	Remarks
62	0-3	Light/Brown Sandy Top Soil Streaks of Iron Staining in Kaolinized Sandstone
	3-6	Iron Stained Kaolin Sandstone
	6-12	Buff Kaolinized Sandstone
	12-15	White Kaolinized Sandstone
	15-24	Buff Kaolinized Sandstone
	24-27	White Kaolinized Sandstone
	27-33	Buff Kaolinized Sandstone
63	0-5	Light/Brown Iron Stained Sandy Soil
	5-7'6"	Buff/Off White Kaolin Sandstone
	7'6" - 22'6"	White Kaolin Sandstone
	25'-32'6"	Buff Kaolin Sandstone
	32'6"-50'	High Plasticity Clay
64	0-3	Orange/Light Brown Sandy Clay Topsoil
	3-6	Buff/Off White Kaolinized Sandstone Capping - Hard
65	0-5	Light/Brown Sandy Clay
	5'-7'6"	Off White Kaolinized Sandstone Hard Capping (Hard Abandoned)
66	0-5	Light/Brown Orange Sandy Clay
	5' - 15	White Kaolinized Sandstone
	15 - 30	Off/White Kaolinized Sandstone
	30 - 40	Buff Kaolinized Sandstone
	40 - 42'6"	Talcose Kaolin
	42'6" - 50	Buff Talcose Kaolin
	50 - 55	Buff Talcose Kaolin
67	0-5	Buff Kaolinized Sandstone
	5 - 12'6"	White Kaolinized Sandstone
	12'6"-17'6"	Cream Kaolinized Sandstone
	17'6"-22'6"	White Kaolinized Sandstone (Hard Abandoned)

Hole No.	Feet Depth	Remarks
68	0-5	Red/Brown Iron Stained Sandstone
	5 - 7'6"	Cream Kaolinized Sandstone
	7'6"-15	White Kaolinized Sandstone
	15'-22'6"	Buff/White Kaolinized Sandstone
	22'6"-35'	Buff Clay Sandy - Soft grading into High Plasticity Clay
69	0-5	Red/Brown Iron Stained Clay
	5' - 7'6"	Brown/Buff Kaolin Sandstone
	7'6"-35	Brown Sandstone
	35 - 40	Brown Sandstone
70	0-3	Red/Brown Iron Stained Sandstone
	3-6	Red/Brown Iron Stained Sandstone Traces of White Kaolin
	6-9	Buff Sandstone some Kaolin
	9-12	Buff Sandstone some Kaolin
	12-27	White Sandstone
	27-42	Buff Sandstone
71	0-3	Red/Orange Iron Stained Sandstone
	3-6	Red/Orange Iron Stained Sandstone White traces of Kaolinized Sandstone Capping - To hard
72	0-3	Red/Brown Iron Stained Sand Stone and Quartz (Hard Abandoned)
73	0-6	White Kaolinized Sandstone Capping (Hard abandoned)

Hole No.	Feet Depth	Remarks
74	0-3	Red/Brown Sandstone
	3-6	Red/Brown Sandstone Traces of Kaolin
	6-9	Pink/Off White Kaolinized Sandstone
	9-18	Pink/Off White/Brown Stained Sandstone
75	0-5	Red Iron Stained Sandstone
	5'-7'6"	White Sandstone some Kaolin
	7'6"-15	White Kaolinized Sandstone
	15 - 20'	White Kaolinized Sandstone
	20'-22'6"	White Kaolinized Sandstone with Fibrous masses Decomposed Asbestos - Sillemenite
	22'6" - 30	Cream/Buff Sandstone
	30' - 35	White Sandstone - Kaolin low % Clay
	35' - 40'	Buff Sandstone
76	0-3	Iron Stained Sandstone Red/Brown
	3-6	As above with traces of Kaolin
	6-9	Pink Sandstone
	9-12	Off/White Kaolinized Sandstone
	12-21	Ditto
	21-24	Buff Sandstone
77	0-3	Iron Stained Sandstone
	3-6	Off White Kaolinized Sandstone
	6-30	Ditto
78	0-3	Grey Sandy material traces of Kaolin
	3-6	Grey Off White Kaolin Sandstone
	6-21	White Kaolin
	21-33	Buff Kaolin) High Plasticity
	33-42	Off White Kaolin) Clay

Hole No.	Feet Depth	Remarks
79	0-3	Brown Sandy Soil
	3-6	Pink Buff Iron Stained Sandstone
	6-18	White Kaolin Sandstone
80	0-5	Buff Sandstone
	5 - 7'6"	Buff Kaolinized Sandstone
	7'6"-35	Buff Kaolinized Sandstone
81	0-3	Buff Hard Sandstone
	3-6	Buff Hard Sandstone traces of Kaolin capping
82	0-3	Light/Brown Grey Sandy soil traces of Kaolin
	3-6	Buff Kaolinized Sandstone
	6-12	Buff Kaolinized Sandstone Capping (Hard Abandoned)
83	0-3	Light/Brown Topsoil traces of Kaolin
	3-6	Light/Brown Topsoil traces of Kaolin Capping (Hard Abandoned)
84	0-3	Light/Brown Iron Stained Sandstone
	3-30	Off White Kaolinized Sandstone Gritty
85	0-3	Brown Gritty Clay and Hard Quartz Veins (Hard Abandoned)
86	0-3	Light/Brown Sandy Clay and Hard Quartz Veins (Hard Abandoned)
87	0-5	DarkBrown Clay and Quartx traces of Kaolin
	5 - 7'6"	White Sandstone
	7'6" - 10'	Buff Sandstone
	10' - 12'6"	Buff Sandstone (Hard Abandoned)
88	0-3	Sandy/Brown Topsoil Quartz Stringers (Hard Abandoned)

GR Hole 6

0-6	Buff Hard Kaolin Sandstone
6-9	Cream Kaolin Sandstone
9-12	White/Purple Iron Stained Sandstone
12-15	White Kaolinized Sandstone

GR Hole 7

0-6	Grey Clay
6-24	Buff Clay

GR Hole 8

0-6	White Kaolinized Sandstone
6-15	Buff/Grey Clayey Sandstone

GR Hole 9

0-6	Brown Iron Stained Sandstone
6-12	Grey Clayey Sandstone

GR Hole 10

0-6	Brown/Grey Topsoil and Subsoil
6-15	White Clayey Sandstone

GR Hole 11

0-6	Off/White Kaolinized Sandstone
6-9	Soft White Sandy Kaolin
9-24	White Kaolinized Sandstone

GR Hole 12

0-6	Grey Kaolinized Sandstone
6-9	Grey White Falcose Clay
9-24	Buff Kaolin

GR Hole 13

0-6	Pink/Cream Sandstone
6-24	Buff Sandstone

GEMCO RIG HOLES IN SECTION 169

GR Hole 14

0-6	Black Topsoil grey clay Subsoil
6-24	Off White Kaolinized Sandstone

GR Hole 15

0-6	Brown Sandy Topsoil
6-9	Orange Sandy Clay
9-21	Orange/Yellow Sandy Clay

GR Hole 16

0-6	Grey Clay Sandstone
6-9	White Kaolinized Sandstone
9-24	Off/White Kaolin Clay

GR Hole 17

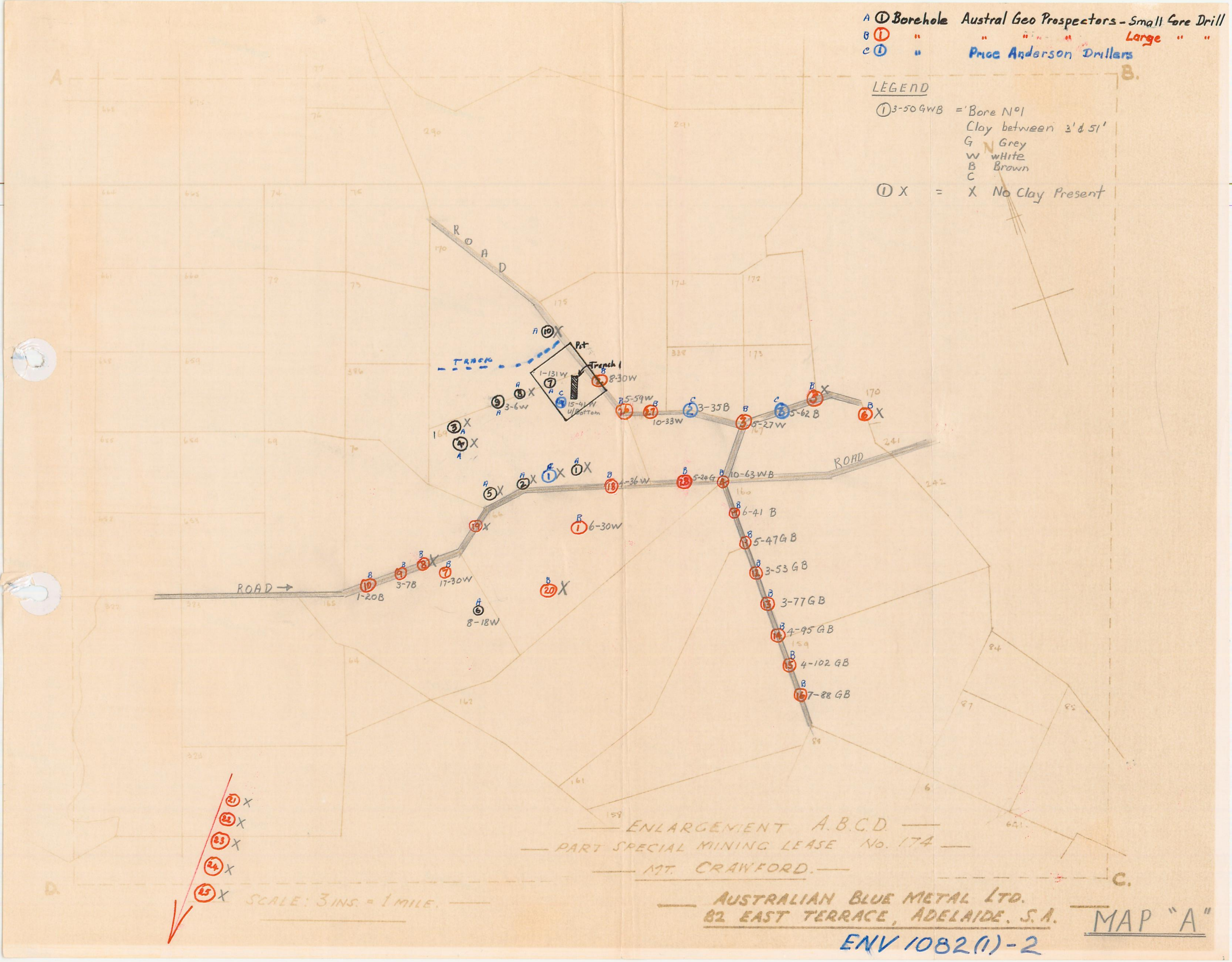
0-6	Grey/Brown Clay
6-18	White/Grey Kaolin

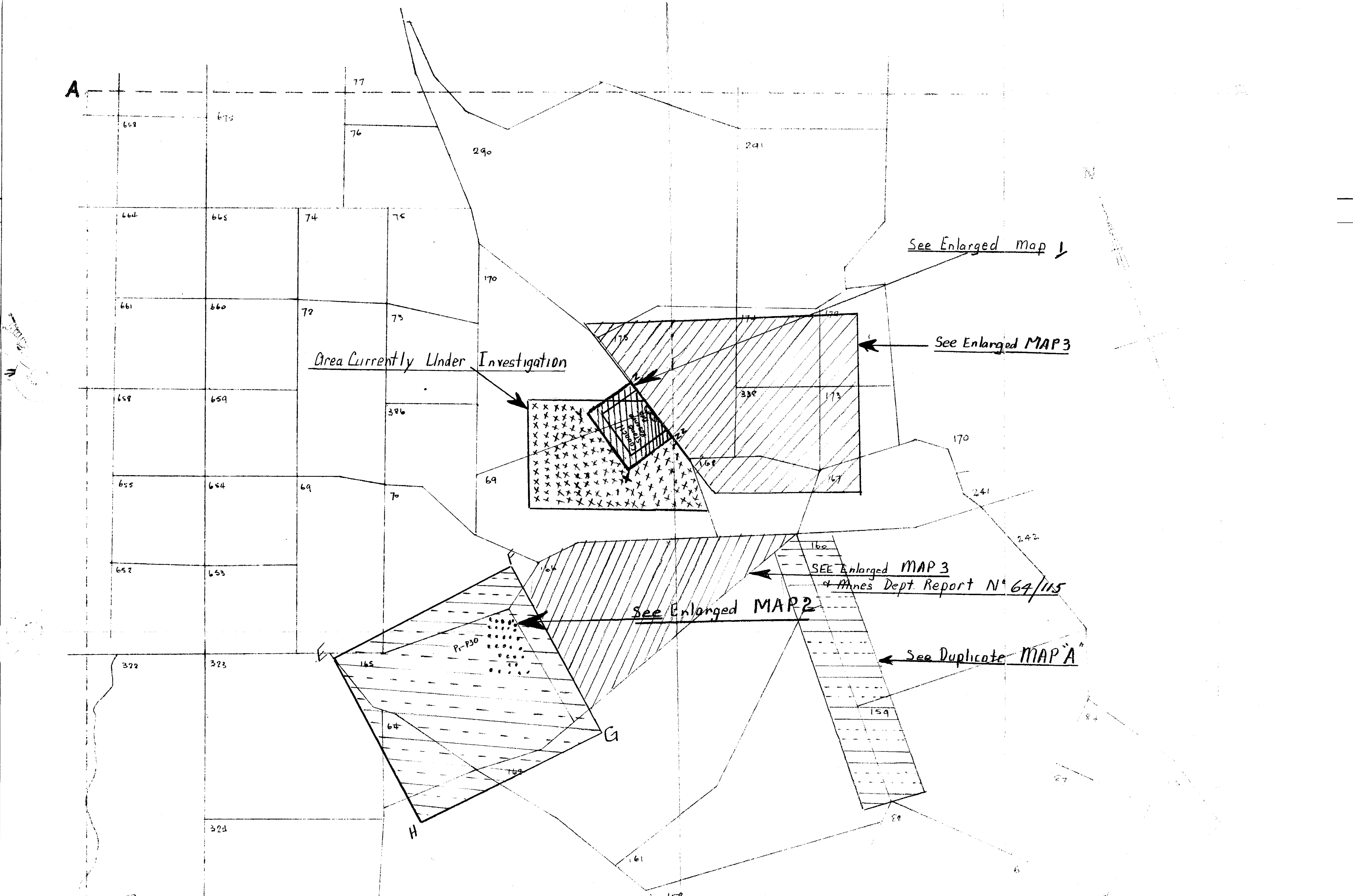
GR Hole 18

0-6	Dark Brown/Orange Clay Clay Topsoil
6-12	Cream Sandstone

ENV 1082(1)-1

MT CRAWFORD
KAOLIN–SILICA DEPOSIT.
PLAN
OF
PRELIMINARY DRILLING, AND LOG OF HOLES.
AUSTRALIAN BLUE METAL LTD.
SCALE: 1 IN. = 120 FT. HOR.
LOGS 1 SECT = 3 FT.


A ① Borehole Austral Geo Prospectors - Small Core Drill
B ① " " " " Large " "
C ① " Price Anderson Drillers
LEGEND
① 3-50 GWB = Bore No 1
Clay between 3' & 51'
G Grey
W white
B Brown
C
① X = X No Clay Present
ROAD
TRACK
Pit
Trench 1
1-131 W
15-41 W
U/Bottom
8-30W
5-59W
10-33W
3-35B
5-27W
5-62 B
3-6w
4-36 W
5-24 G
10-63 WB
6-41 B
5-47 GB
3-53 GB
3-77 GB
4-95 GB
4-102 GB
7-88 GB
6-30W
17-30W
3-7B
1-20B
8-18W
ROAD →
ENLARGEMENT A.B.C.D
PART SPECIAL MINING LEASE No. 174
MT. CRAWFORD.
SCALE: 3 INS. = 1 MILE.
AUSTRALIAN BLUE METAL LTD.
82 EAST TERRACE, ADELAIDE. S.A.
MAP "A"
ENV 1082(1)-2



ENLARGEMENT A.B.C.D.

PART SPECIAL MINING LEASE

MT. CRAWFORD.

Refer. S.M.L. 174, Location Map.

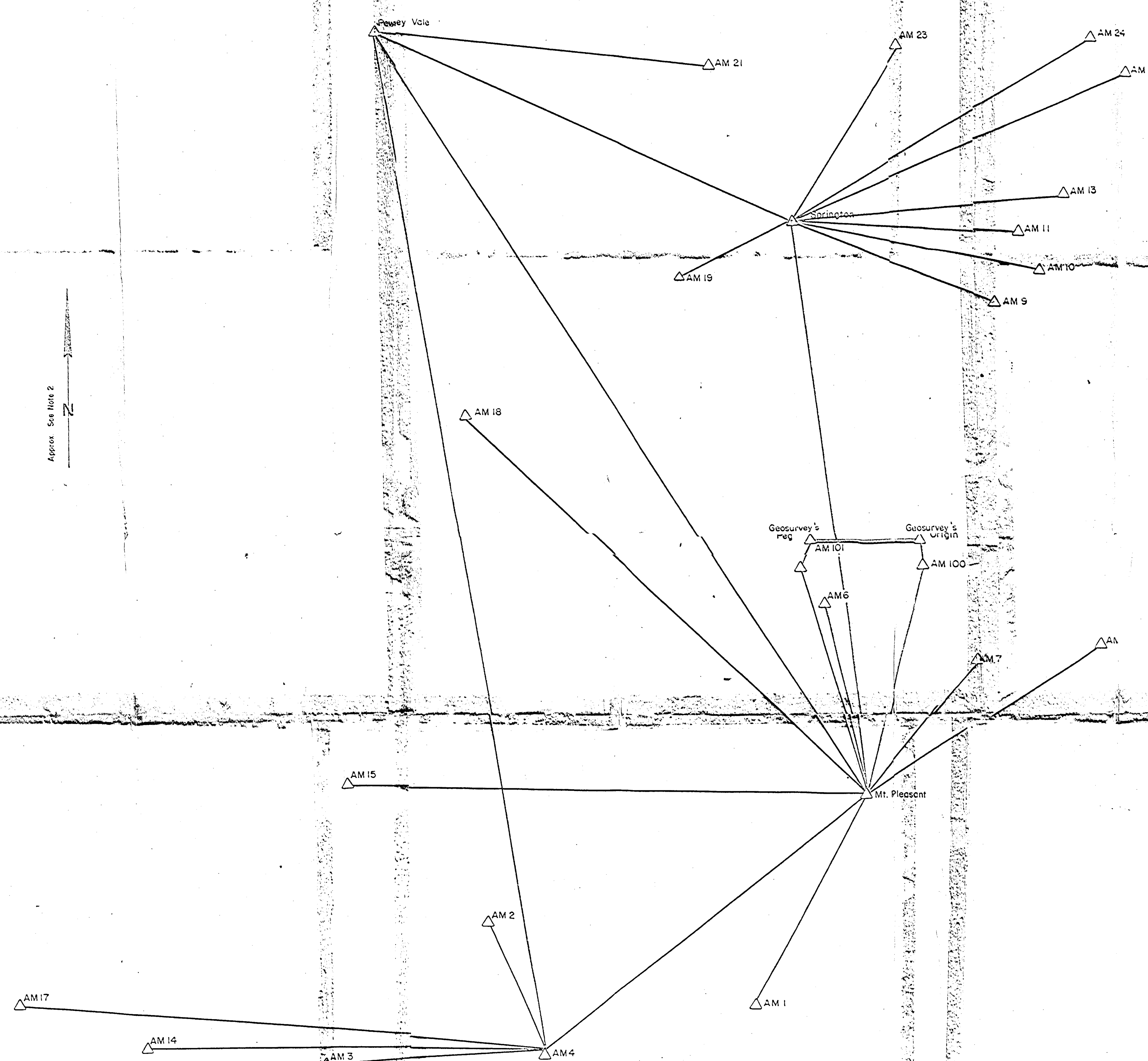
SCALE: 3 INS. = 1 MILE.

AUSTRALIAN BLUE METAL LTD.
82 EAST TERRACE, ADELAIDE, S.A.

KEY MAP

ENV 1082(1)-10

MT. CRAWFORD CONTROL DIAGRAM



POINT	CO-ORDS (METRES) N	CO-ORDS (METRES) E	CO-ORDS (FEET) N	CO-ORDS (FEET) E	HEIGHT (feet)	DESCRIPTION OF MARK
Pleasant	95401·64	100058·15	312997·51	328274·77	1784·0	Trig Ground Mk. in conc. RM's, Beacon
Pewsey Vale	107378·45	92372·44	352291·50	303059·19	2066·5	" " " " " " "
Springton	103407·26	98380·54	339262·66	322770·80	1697 Ground Level	Beacon, centre of 4"x4" Pole
AM 1	92710·62	97877·62	304168·70	321120·80	1593·1	1" G.I. Pipe in Conc. RM's
AM 2	95274·61	95709·81	312580·74	314008·56	1462·2	" " " " " "
AM 3	92302·15	93823·99	302828·57	307821·49	1367·6	" " " " " "
AM 4	92606·62	96574·94	303827·49	316846·91	1651·0	" " " " " "
AM 6	98641·80	98091·60	323627·95	321822·83	1366·0	" " " " " "
AM 7	97517·90	100683·76	319940·61	330327·29	1489·4	1" 3' G.I. Pipe driven to ground. RM's
AM 8	97462·21	101999·56	319757·90	334644·23	1675·1	" " " " " " " "
AM 9	100693·40	103407·00	330358·92	339261·81	1335·2	" " " " " " " "
AM 10	102747·32	100670·67	337097·51	330284·35	1284·0	" " " " " " " "
AM 11	103118·65	103402·67	338315·78	339247·60	1204·0	1" G.I. Pipe in Conc. RM's
AM 12	105602·71	102414·48	346465·58	336005·51	1338·2	" " " " " "
AM 13	103469·41	104230·81	339466·57	341964·59	1171·6	Dumpy Peg RM's
AM 14	92429·99	91704·94	303248·00	300869·22	1493·0	1" G.I. Pipe in conc. RM's
AM 15	95434·96	90954·01	313106·82	298405·54	1603·5	" " " "
AM 17	92727·64	90904·32	304224·54	298242·52	1543·6	" " " "
AM 18	100824·68	94614·29	330789·63	310414·34	1444·8	" " " "
AM 19	102543·89	96912·08	336430·08	317953·02	1452·9	Dumpy Peg RM's
AM 21	105445·67	98129·88	345950·04	321948·42	1757·6	1" G.I. Pipe in Conc. RM's
AM 23	106857·50	99967·96	350582·35	327978·87	1582·1	" " " "
AM 100	99801·94	100024·52	327434·86	328164·43	1389·8	" " " "
AM 101	99949·66	96865·33	327918·83	317799·64	1429·8	" " " "
Origin	100000·00	100000·00	328083·99	328083·99		Peg beneath Centre of Water Tank
AM 24	105930·29	101945·76	347540·32	334467·72	1277·2	1" G.I. Pipe in conc.

NOTES:

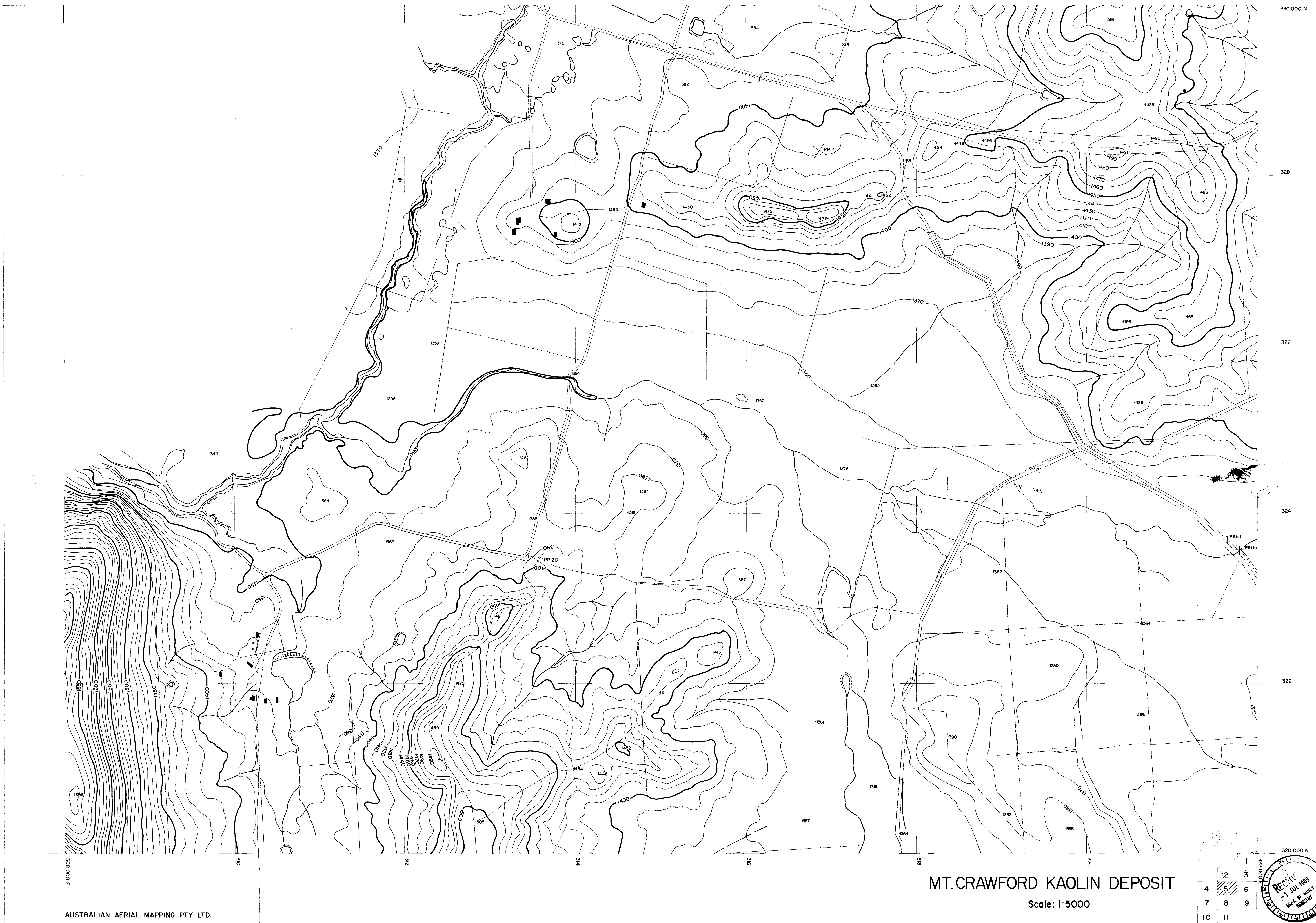
1. Principal Field Measurements made with Wild T2 Theodolites and MRA 2 Tellurometers.
2. ORIGIN OF CO-ORDINATES:

   The table of plane co-ordinates are based upon Geosurveys Origin as indicated on Plan GEO 507 A initial values adopted being: N 100,000 metres
   E 100,000 metres

   Grid Values shown on photogrammetric plans are in feet — the conversion factor metres to feet being 3·2808398
   The initial meridian through the origin adopted for the co-ordinate system is assumed as being at right angles to the base line AM 101 to point of origin.
   Conversion to the State Co-ordinate System may be made through the trigs. Pewsey Vale and Mt. Pleasant.
3. LEVEL DATUM

   Mean Sea Level — Derived by true reciprocal vertical angles to Pewsey Vale and Mt. Pleasant Trigs.
   Values are in feet.

AUSTRALIAN AERIAL MAPPING PTY. LTD.



MT. CRAWFORD KAOLIN DEPOSIT

Scale: 1:5000

AUSTRALIAN AERIAL MAPPING PTY. LTD.

ENV 1082(3)-2

MT. CRAWFORD KAOLIN DEPOSIT

Scale: 1:5000

AUSTRALIAN AERIAL MAPPING PTY. LTD.

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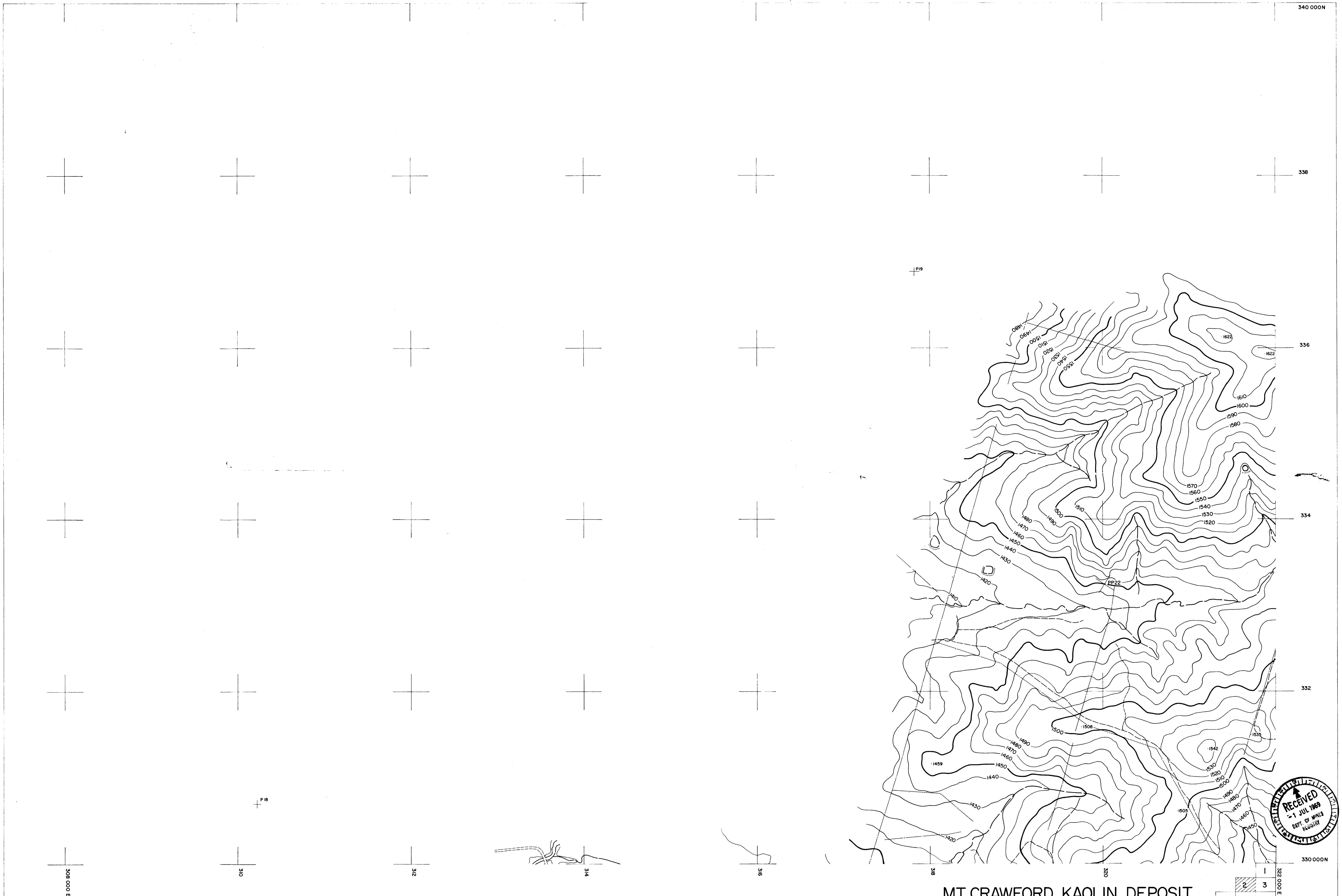
ENV 1082(3)-3



MT. CRAWFORD KAOLIN DEPOSIT

Scale: 1:5000

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7	8	9
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AUSTRALIAN AERIAL MAPPING PTY. LTD.

ENV 1082(3)-4

MT. CRAWFORD KAOLIN DEPOSIT

Scale: 1:5000

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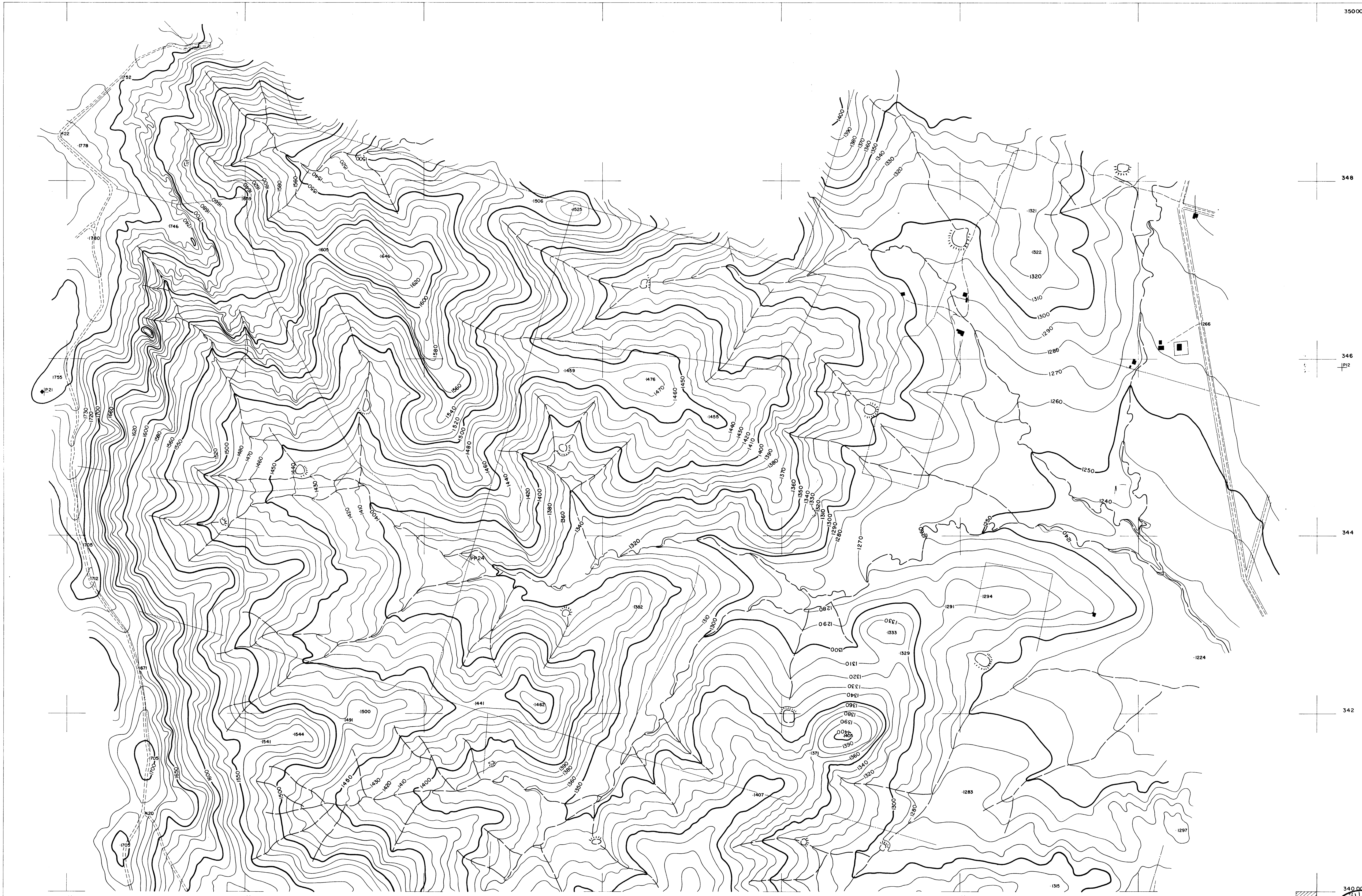
4	5	6
7	8	9
10	11	

AUSTRALIAN AERIAL MAPPING PTY. LTD.

ENV 1012(3)-5



MT. CRAWFORD KAOLIN DEPOSIT

Scale: 1:5000

AUSTRALIAN AERIAL MAPPING PTY. LTD.

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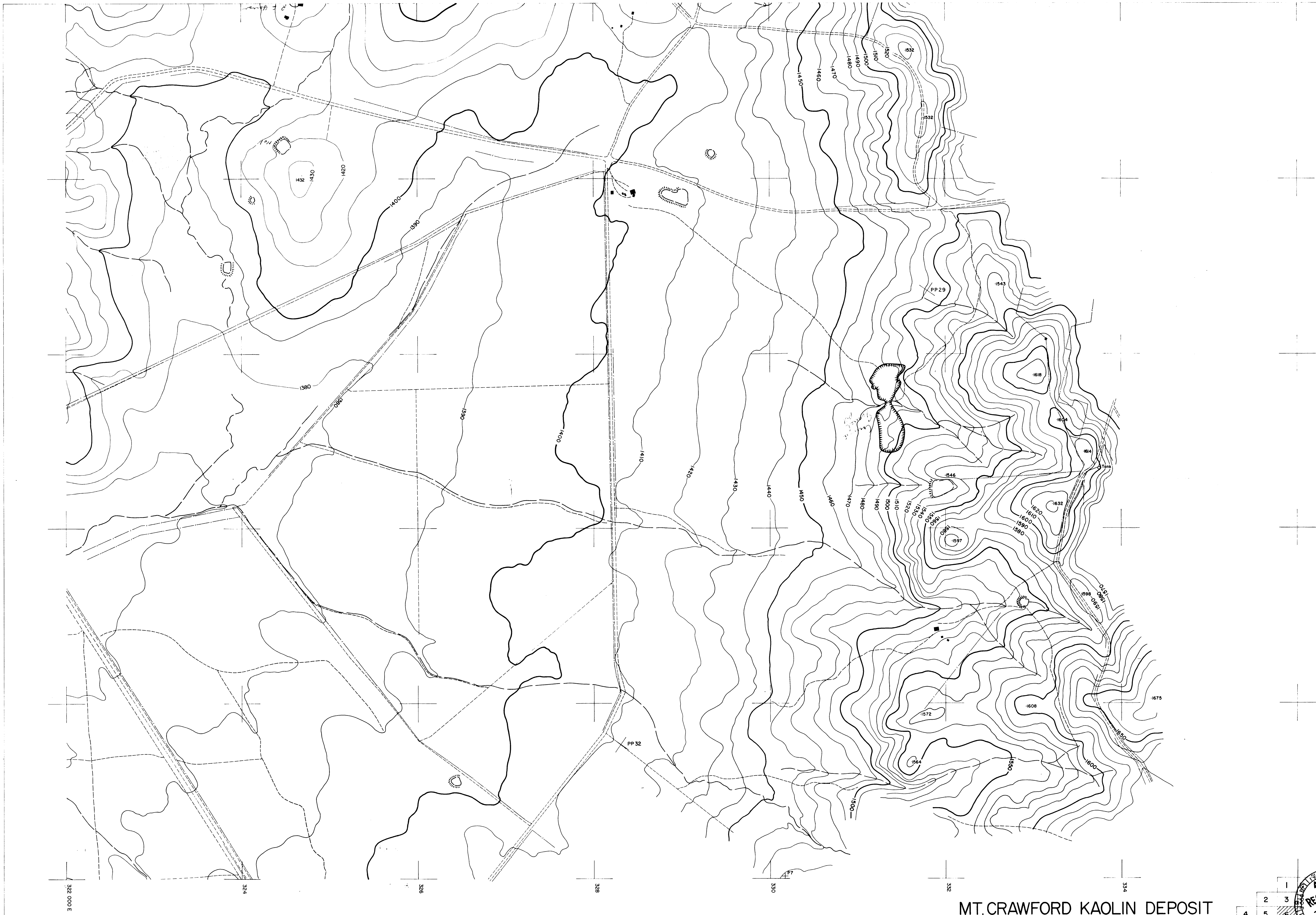
7	8	9
10	11	

ENV 1082(3)-6



MT. CRAWFORD KAOLIN DEPOSIT

Scale: 1:5000

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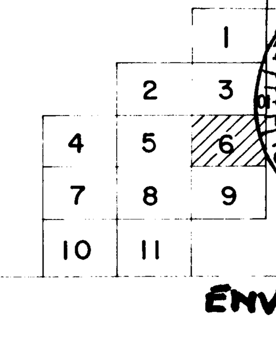

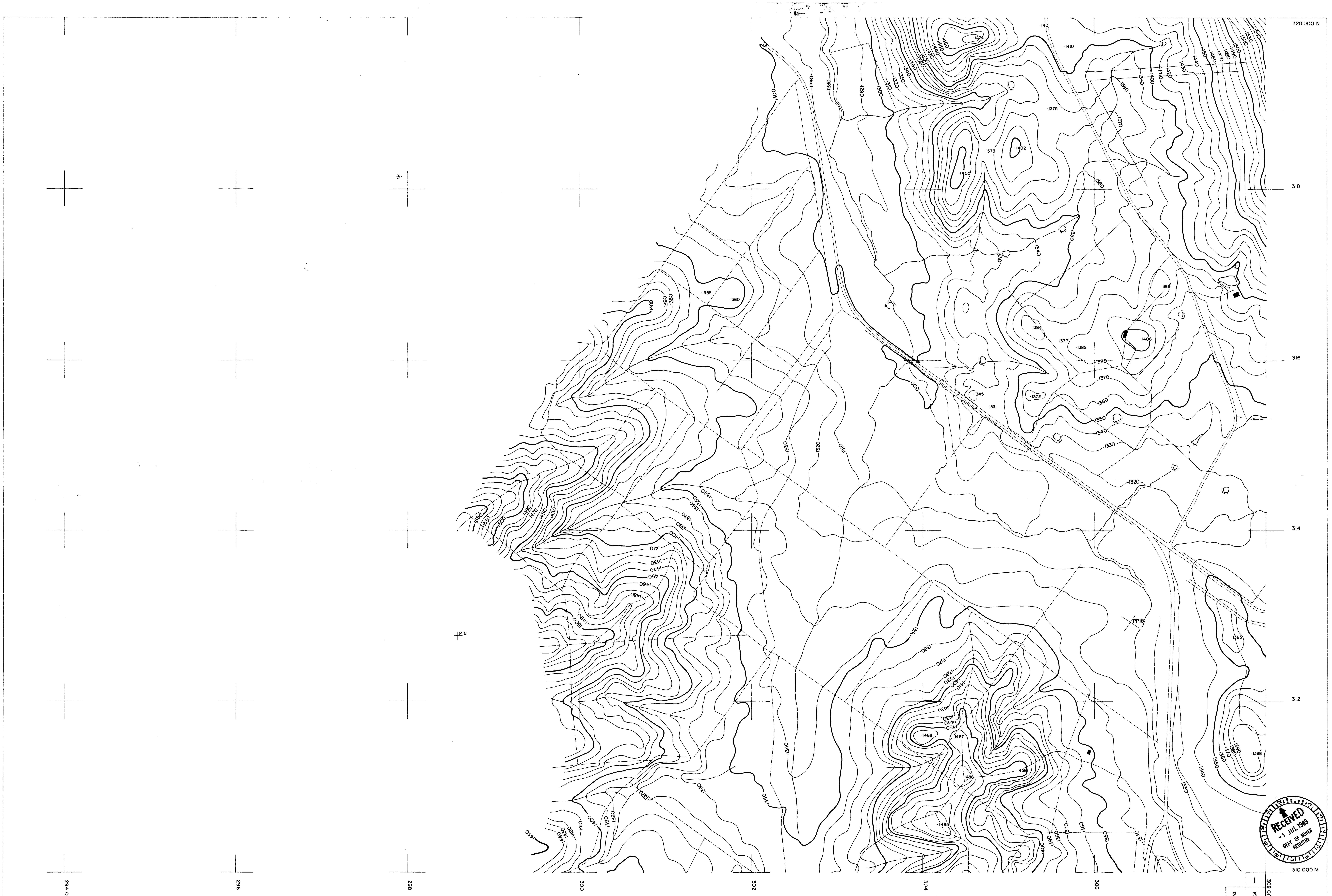

MT. CRAWFORD KAOLIN DEPOSIT

Scale: 1:5000

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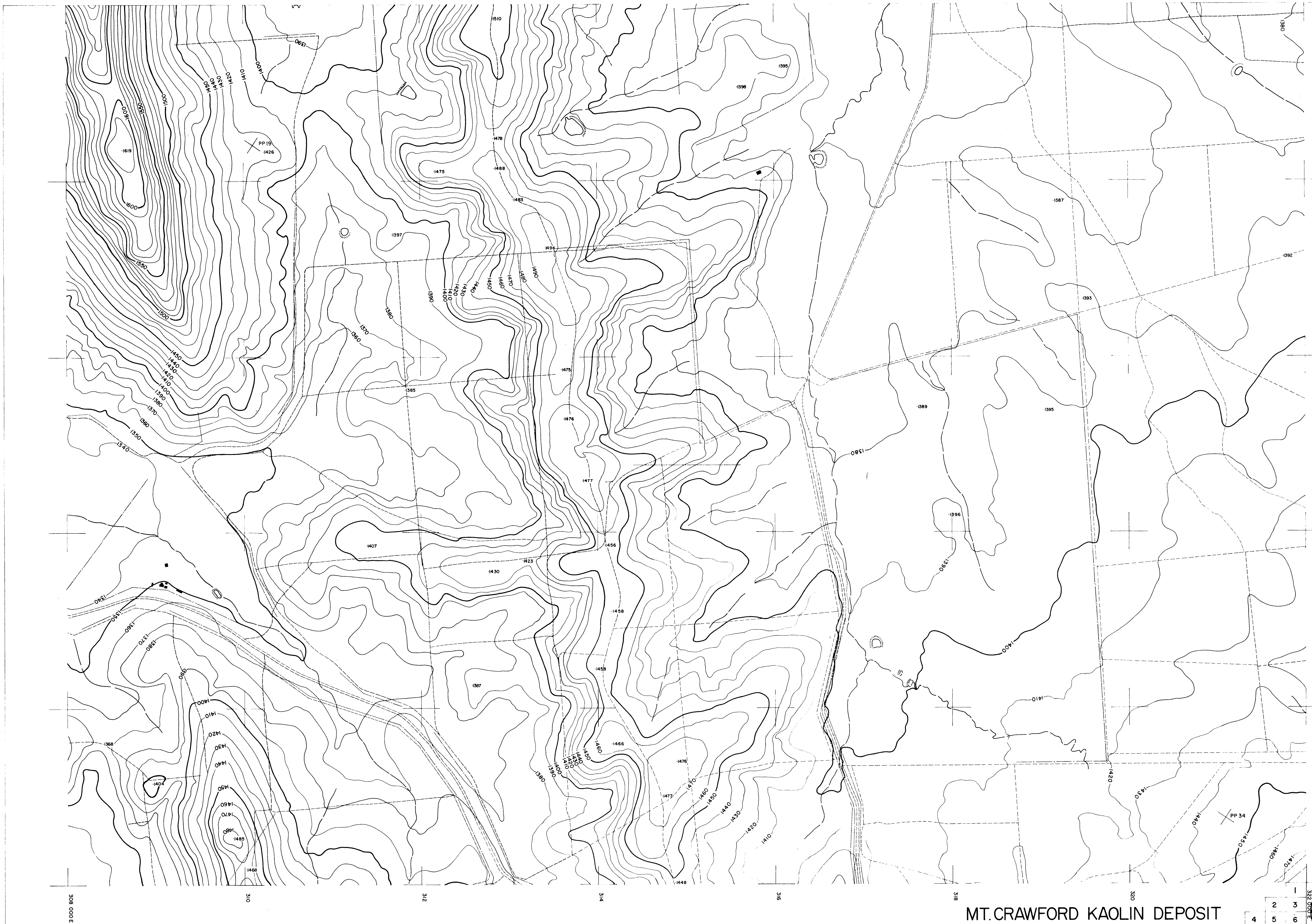
AUSTRALIAN AERIAL MAPPING PTY. LTD.

ENV 1082(3)-8



MT. CRAWFORD KAOLIN DEPOSIT

Scale: 1:5000

AUSTRALIAN AERIAL MAPPING PTY. LTD.

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4	5	6
7	8	9
10	11	

MT. CRAWFORD KAOLIN DEPOSIT

Scale: 1:5000

AUSTRALIAN AERIAL MAPPING PTY. LTD.

ENV 10823-10

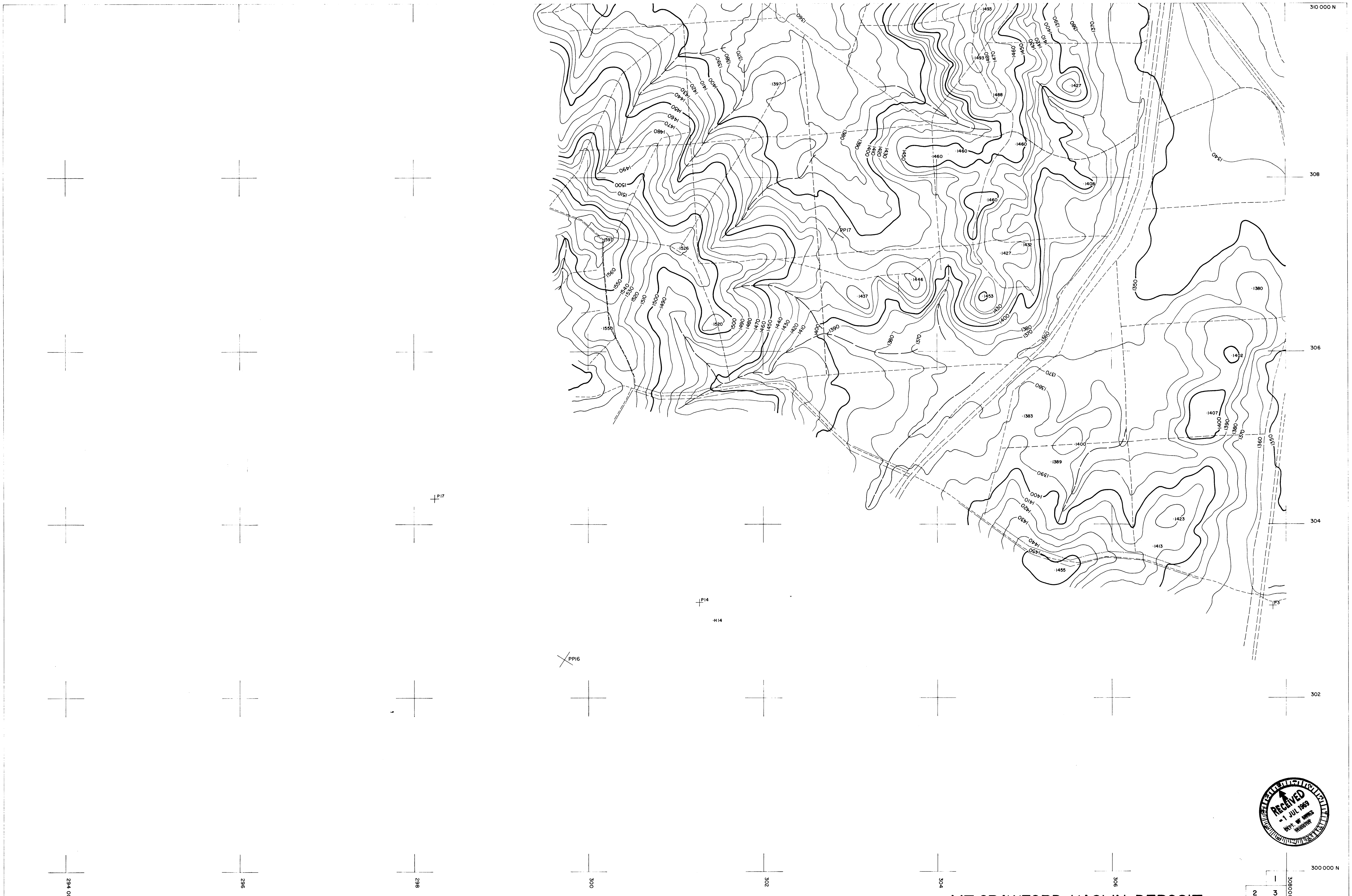
MT.CRAWFORD KAOLIN DEPOSIT

Scale: 1:5000

		1
	2	3
4	5	6
7	8	9
10	11	

AUSTRALIAN AERIAL MAPPING PTY. LTD.

ENV 1082(3)-11



MT. CRAWFORD KAOLIN DEPOSIT

Scale: 1:5000

		1
	2	3
4	5	6
7	8	9
10	11	

AUSTRALIAN AERIAL MAPPING PTY. LTD.

ENV 1082(3)-12