DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

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COAL EXPLORATION IN THE LEIGH CREEK-FARINA AREA, SOUTH AUSTRALIA. EXPLORATION LICENCE 938, FINAL REPORT.

GEOLOGICAL SURVEY

by

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ABSTRACT

The results of previous gravity surveys and coal drilling programmes in the Leigh Creek-Farina area were reinterpreted. A new gravity survey consisting of 1000 optically levelled gravity stations on a 500 m square grid and covering 250 sq. km was conducted over a prospective area at Tom Hill.

Coal targets defined by the Tom Hill gravity survey and from the reinterpretation of previous gravity programmes were investigated by drilling. Eleven boreholes, totalling 285 m of open-hole rotary drilling were completed without discovering any coal or coal-bearing sediment. The negative bouger anomalies were due to bedrock depressions filled with unconsolidated Tertiary and Quaternary sediment; deeply weathered bedrock, or marked changes in bedrock lithology.

Based on the geophysical and geological data available to date, the prospective area in EL 938 has been adequately explored and no further worked is warranted.

INTRODUCTION

The report reviews previous gravity and drilling investigations and details the results of a coal exploration programme on Exploration Licence 938.

Exploration Licence 938 was granted to the Electricity Trust of South Australia (ETSA) on the 29th November, 1981 for a term of one year for a joint ETSA-SADME coal exploration programme to investigate the potential for Triassic coal basins concealed beneath alluvium covered areas north and northwest of the Leigh Creek Coalfield. The discovery of a Triassic coal deposit in

close proximity to the Leigh Creek Coalfield or the Pt. Augusta-Marree railway could significantly influence ETSA's future development plans for the Leigh Creek Coalfield and the Northern Power Station.

In addition to the coal exploration conducted on EL 938 several exploration boreholes were drilled to the west of and within the Leigh Creek Mining Lease. The boreholes outside the Exploration Licence and Mining Lease were drilled in mineral claims with the approval of the SADME and the landowner. The results of this drilling are also included in this report.

LOCATION

Exploration Licence 938 covers an area of approximately 1791 square kilometres and is located immediately north of the Leigh Creek Coalfield (Figure 1). The southern boundary of the licence abuts the northern limit of ETSA's Leigh Creek Mining Lease. The area is traversed centrally by the Leigh Creek to Marree unsealed road and the Pt. Augusta-Marree railway (Figure 2). The main centre of population is the new mining township of Leigh Creek South (population 2000) which is located 25 km south of the licence area.

EXPLORATION RATIONALE

At the Leigh Creek Coalfield, Middle Jurassic sediments lie directly above the Triassic Upper Series coal seams (Hos, 1978). The reporting by Coats, 1973 of the occurrence of Middle Jurassic sediments at Tom Hill suggested the possibility of concealed Triassic coal bearing sediments in this area and under the extensive alluvium covered areas of the licence.

Previous coal exploration programmes were limited and did not extend to Tom Hill, therefore an extension of the previous surveys to cover the Tom Hill area was considered justifiable.

In addition, a reinterpretation of earlier exploration surveys was undertaken in case any potential coal targets were overlooked or inadequately drilled.

GEOLOGICAL SETTING

North and northwest of Leigh Creek is an extensive area of plains country bounded by outcropping Adelaidean bedrock. The plains consist of a discontinuous veneer of Recent, Quaternary and Tertiary sediment unconformably overlying a peneplained surface of Adelaidean bedrock.

The only known Triassic sediments in the Leigh Creek area occur in four, approximately circular, closed basins which vary from 2 to 20 square kilometres in area. These basins are circumscribed and separated by Adelaidean sediments and form complete structural units with radial dips and marked unconformity with the underlying bedrock. The maximum thickness of Triassic sediment in these basins ranges from 130 m (Lobe D) to over 1 000 m (Lobe B). The great thickness of Triassic sediment is incompatable with deposition within the limits of the existing basins and it may be inferred that the Triassic sediments were originally widespread, with the present basins representing in-folded erosional remnants (Parkin, 1953).

In the Leigh Creek Coalfield the Triassic sediments consist of grey shales, carbonaceous shales and coal seams with interbedded sandy shales and occasional sandstones. The Middle Jurassic sediments occur only above the Upper Series (Triassic) coal seams in Lobe B and consist of slightly carbonaceous mudstones and siltstones. The coal basins are unconformably overlain by a flat, discontinuous cover of Quaternary and Recent sediments rarely exceeding 10 m. in thickness.

PREVIOUS INVESTIGATIONS

Gravity Surveys

Previous coal exploration programmes in the Leigh Creek area used gravity surveys to investigate alluvium covered areas and define potential drilling targets. Most of the gravity surveys were undertaken between 1947 and 1952 by the Bureau of Mineral Resources (BMR) with subsequent extensions carried out by the South Australian Department of Mines and Energy. Reference to these surveys are given in Parkin (1953).

The gravity investigations conducted for coal exploration since the early BMR surveys are:

1. Pegum (1962) established 140 gravity stations on a 800 m square grid to fill in the previous coverage to the west of and between the existing basins in the Leigh Creek Coalfield.
2. Mumme and Moorcroft in 1961 (Meyer, 1974) conducted the Lake Watherston survey and established 340 gravity stations on an 800 m grid to extend previous BMR surveys to the west as far as Termination Hill.
3. In 1980 Broken Hill Proprietory Co. Ltd. established the Avondale gravity grid around the Avondale homestead. Approximately 266 gravity stations were established at 200 m intervals along 7, E-W traverse lines, 2 kilometres apart. In addition, a single E-W gravity line (54 stations) was completed near Rocky Dam.

The location of previous gravity surveys are shown on Figure 2 and the compilation and reduction of the field data from these surveys are presented in a separate report by Love (1982, in prep.).

Drilling

Prior to the current programme, 38 coal exploration boreholes totalling 2 355 m were drilled in the search for new Triassic coal basins north of the Leigh Creek Coalfield. The drilling statistics are summarised in Table 1 and the location of the boreholes are shown on Figure 5.

The first coal exploration drilling outside the known Triassic coal basins in the Leigh Creek area was conducted in 1944. Three boreholes N1, N2 and NW1 each penetrated Adelaidean bedrock at shallow depths (Parkin, 1953).

From 1948 to 1950 six boreholes (GA1 to GA6) were drilled to test gravity anomalies delineated by the BMR gravity surveys. All failed to intersect coal-bearing sediments but showed the existence of variable thickness of Quaternary and Tertiary sediments in bedrock depressions (Parkin, 1953).

An additional 12 boreholes (GA6 to GA18) were drilled in 1961 to test the results of Pegum's gravity investigation and targets defined by a reinterpretation of previous gravity data and drilling results (Hillwood, 1964). The drilling failed to intersect coal or Triassic sediment.

In 1973, three boreholes (LW1 to LW3) were drilled to test negative gravity anomalies defined by the Lake Watherston survey. Drilling showed that the anomalies were caused by low density, highly weathered Adelaidean rocks or Quaternary and Tertiary sediment-filled bedrock depressions (Meyer, 1974).

In 1981 Broken Hill Proprietary Co. Ltd. conducted a drilling programme for diamonds and coal within Exploration Licence 576. Fourteen coal exploration boreholes (AV1 to AV14) were drilled to test gravity anomalies in the Avondale and Lyndhurst areas. Drilling indicated that the negative gravity

TABLE 1 PREVIOUS COAL EXPLORATION DRILLING IN THE LEIGH CREEK AREA

COMPANY/ORGANISATION	HOLE	DATE DRILLED	TOTAL DEPTH m	CORED INTERVAL From - To m	GEOPHYSICAL LOGS *
S.A. DEPARTMENT OF MINES	N1 N2 NW1	))1944)	no information		
S.A. DEPARTMENT OF MINES	GA1	19/3/48	39.01	-	-
	GA2	9/8/48	38.10	-	-
	GA3	30/8/48	54.87	-	-
	GA4	3/7/50	62.79	-	-
	GA5	10/7/50	96.01	-	-
	GA6	18/8/50	121.92	-	-
S.A. DEPARTMENT OF MINES	GA7	30/11/61	172.21	60.96- 64.01 170.69-172.21	-
	GA8	2/12/61	121.92	-	-
	GA9	5/12/61	121.92	-	-
	GA10	5/12/61	24.38	-	-
	GA11	6/12/61	30.48	-	-
	GA12	6/12/61	12.19	-	-
	GA13	6/12/61	12.19	-	-
	GA14	6/12/61	12.19	-	-
	GA15	9/12/61	99.06	97.54- 99.06	-
	GA16	12/12/61	74.68	73.15- 74.68	-
	GA17	14/12/61	80.77	79.25- 80.77	-
	GA18	6/1/62	58.83	57.91- 58.83	-
S.A. DEPARTMENT OF MINES	LW1	20/9/74	19.00	-	-
	LW2	21/9/74	46.00	24.23- 46.00	-
	LW3/3A	24/9/74	38.13	10.00- 12.75 19.56- 22.63 33.60- 38.13	-
B.H.P. COMPANY PTY. LTD.	AV1	22/5/80	84.00	-	G.R.SP.D.
	AV2	23/5/80	108.00	-	G.D.
	AV3	24/5/80	98.00	-	G.D.
	AV4	24/5/80	72.00	-	-
	AV5	26/5/80	70.00	-	-
	AV6/6A	29/5/80	96.00	94.00- 94.80	G.D.
	AV7	27/5/80	102.00	-	G.R.SP.D.
	AV8	28/5/80	84.00	-	-
	AV9	31/5/80	36.75	36.00- 36.75	G.D.
	AV10	31/5/80	42.00	-	G.D.
	AV11	1/6/80	82.00	62.00- 67.80	G.D.
	AV12	22/7/80	46.30	-	G.
	AV13	23/7/80	47.00	-	-
	AV14	23/7/80	50.00	-	G.
TOTAL:	38 boreholes		2354.7 metres		

* G.=Gamma, R.= Resistivity, SP.= Self Potential, D.=Density

anomalies were predominantly due to bedrock depressions filled with unconsolidated Quaternary and Tertiary sediments. However, the anomaly centred on Avondale was interpreted as being an anticlinal structure in Adelaidean bedrock consisting of a core of weathered quartzose sandstone and siltstone (Copley Quartzite) surrounded by a relatively denser sequence of massive dolomites and dolomitic siltstone of the Skillogalee Dolomite. Intersections of carbonaceous sediment were reported in boreholes AV4, AV6, AV7 and AV11. A palynological examination of samples from VA6 and AV7 revealed that the sediment were highly carbonised and are probably of Proterozoic age. In AV4 the carbonaceous unit was interpreted as Tertiary sediment but examination of the drill-cuttings submitted to the SADME Core Library has shown that the carbonaceous intersections are grey shale in the bedrock. All the carbonaceous intersections recorded by BHP are now interpreted as intersections of an unoxidised grey shale unit within the Adelaidean Myrtle Springs Formation.

Drilling in 1980 for water by the local landowners and for diamonds by Broken Hill Proprietory Co. Ltd. (1981) (Figure 5) all encountered bedrock at shallow depths.

EXPLORATION PROGRAMME

The following investigations have been carried out:

- a gravity survey at Tom Hill,
- a reinterpretation of previous gravity surveys,
- an exploration drilling programme.

Tom Hill Gravity Survey

A gravity geophysical method was used to define potential drilling targets in the search for concealed coal basins in the Tom Hill area.

Limitations to the gravity method as applied to the search for concealed Triassic basins, are: (i) small basins with a limited thickness of coal-bearing sediment could be overlooked if they produce an anomaly of less than 1 milligal, and (ii) areas with low Bouguer gravity values may also indicate accumulations of unconsolidated Recent, Quaternary and Tertiary sediment, or reflect marked lithological changes in the bedrock.

Alternative methods such as seismic and resistivity profiling were considered too costly because of the large area of investigation and the small size of the target sought.

A Lobe D (Leigh Creek Coalfield) basin was chosen as the minimum size target for exploration. The basin is saucer-shaped and approximately 2 km in diameter with a maximum thickness of Triassic sediments of 130 m resting unconformably on Adelaidean bedrock. It contains two coal seams ranging in thickness from 6 m to 9 m with total initial coal reserves of 23 million tonnes (Figure 3).

A Lobe D basin should theoretically produce a maximum gravity anomaly of between 2 and 2.5 milligals when assuming a density contrast of approximately 0.6 gm/cc between Triassic sediment and Adelaidean bedrock (Figure 3). Earlier fieldwork by Pegum (1962) recorded a 3 milligal anomaly over Lobe D which supports this assumption.

To detect a Lobe D or larger Triassic coal basin and to ensure that about 3 gravity stations with at least a 2 milligal contrast occurred within the basin a 500 m gravity station grid was selected.

A ground gravity survey was completed over an area of approximately 250 square kilometres in the Tom Hill area and consisted of 1 000 optically levelled gravity stations on a

500 metre grid (Figure 4). An accurately surveyed baseline orientated 135°N was initially established in the area by ETSA surveyors using trig points on Mt. Lyndhurst and Tom Hill. The surveying company Calder, Calder and Associates were subsequently contracted to survey and peg the grid and this was completed in December 1981. No access preparation was necessary because the grid area was accessible by 4-wheel drive vehicle.

The SADME (Geophysics Section) completed the field gravity reading between December 1981 and January 1982 and finalised the data reduction and contouring by March 1982. The field procedures and data reduction are presented in a separate report by Love (1982). The field gravity values, and surveying data are available from SADME under Gravity Survey Code 81E 4.

No strong negative bouguer anomalies were revealed by the Tom Hill Gravity Survey, although several weak anomalies with magnitudes of between 2 and 3 milligals were detected. These were investigated by drilling boreholes FA1, FA2, FA3 and FA5.

A northwest-southeast line of weak negative anomalies of 1 milligal magnitude and located in the centre of the survey area were interpreted as a lithological change in bedrock and were not drilled. This was confirmed by a field traverse over an anomaly located 3 km east of Tom Hill, which revealed a strongly weathered and kaolinised shale/siltstone unit with a bedding strike equivalent to the orientation of the anomaly.

Reinterpretation of Previous Gravity Surveys

The reinterpretation of previous gravity surveys was undertaken to ensure that potential coal targets were not overlooked in earlier coal exploration programmes and as a result the following gravity anomalies were defined as potential drilling targets:

- a 2 milligal anomaly at the northern extremity of Lake Watherston, recorded by the Mumme and Moorcroft gravity survey (see drilling results for FA4);
- 2 anomalies of a 1 to 2 milligal magnitude west of Lobe B, recorded by Pegum's 1961, gravity survey (see drilling results for LC1, LC2, and LC3).

The matching of data from the more recent Lake Watherston, Avondale and Tom Hill gravity surveys with the earlier BMR grid was not possible because of the unavailability of base-station and surveying data and this accounts for the discontinuous bouger contours on Figure 5.

Exploration Drilling

Eleven coal exploration boreholes, totalling 285 m of open-hole drilling were completed in the Leigh Creek-Farina area by Thompson Drilling Co. using a Mayhew 1 000 rig. The rig was mobilised from Adelaide on the 18th May 1982 and demobilized from Leigh Creek on the 28th May 1982.

All boreholes were drilled with a 120 mm diameter blade bit, using a rotary-mud circulation method. Borehole lithological descriptions were based on cuttings collected at 2 m intervals and these samples have been submitted to the SADME Core Library.

The geophysical logging was undertaken by Century Geophysical Corporation of Australia using a truck mounted "Compu-Log" system capable of a direct analog read-out and magnetic tape data storage. The geophysical log suite included a caliper, density, natural gamma, neutron-neutron, resistivity, S.P. and deviation probes. All the boreholes were back-filled with cuttings after the geophysical logging was completed.

Drilling and geophysical logging statistics are presented in Table 2 and the borehole locations are shown in Figure 5. The borehole geological logs are contained in Appendix 1 and the geophysical logs are available from the SADME Geophysical Log File (GL2881 to GL2895).

All boreholes were terminated in Adelaidean bedrock at depths ranging from 8 m to 85 m without encountering coal or Triassic sediments.

Boreholes FA1, FA2, FA3 and FA5 were drilled to test negative bouguer anomalies defined by the Tom Hill Gravity Survey. A weathered quartzitic sandstone (Copley Quartzite) overlain by a thin cover of Recent soil and scree was drilled in boreholes FA1, FA3 and FA5. Borehole FA2 penetrated 80 m of soft, weathered (kaolinised) siltstone and shale (Myrtle Springs Formation) before intersecting hard, un-weathered shale.

Boreholes FA4, LC1, LC2 and LC3 were drilled on anomalies defined by the reinterpretation of previous SADME gravity surveys. Borehole FA4 was terminated at 46 m in a hard, green-grey quatzite (Copley Quartzite) at the base of a strongly lateratised silty-clay unit, overlain by 34 m of Quaternary Avondale Clay and Recent alluvium. A dolomitic unit (Balcanoona Formation) with a thin cover of Recent and Quaternary sediment was drilled in boreholes LC1 and LC2. Borehole LC3 intersected weathered, multi-coloured shales of the Tapleys Hill Formation under 1 m of soil cover.

Boreholes LC4, LC5 and LC6 were drilled within the Leigh Creek Mining Lease to test alluvium covered areas between Lobe B and Lobe C where no previous drilling had been undertaken. The holes intersected Adelaidean siltstones and shales at shallow depths ranging from 2 m to 5 m under a cover of unconsolidated, Recent alluvium and Quaternary Telford Gravel.

TABLE 2 LEIGH CREEK-FARINA COAL EXPLORATION:- BOREHOLE DRILLING AND GEOPHYSICAL LOGGING DATA

DRILLING

	DATE	HOLE No.	DEPTH m	TRAVEL (hr.)	SERVICE (hr.)	DRILLING (hr.)	SITE MOVE (hr.)	STAND -BY (hr.)	COMMENTS
	18&19/5/82	MOBILIZATION FROM ADELAIDE TO LEIGH CREEK							
FARINA-EL938	22/5/82	FA1	12						FA4 -1 m hardrock (tri-cone) drilling for 1 hr. Materials: 2x4 3/4" bit, 10kg. Biogel, 2 bags Rapidgel, 1 bag Q-broxin
	23/5/82	FA2	85						
	23/5/82	FA3	12						
	23/5/82	FA4	46						
	24/5/82	FA5	36						
		TOTAL 5	191	5.50	0.50	5.50	11.75	4.50	
LEIGH CREEK AREA	25/5/82	LC1	24						Materials: 1x4 3/4" bit, 10 kg. Biogel, 15 bags Rapidgel
	"	LC2	8						
	"	LC3	18						
	"	LC4	18						
	"	LC5	14						
	"	LC6	12						
		TOTAL 6	94	0.25	0.25	5.25	2.75	0.25	
	28/5/82	DEMOBILIZATION - LEIGH CREEK TO ADELAIDE							

CONTRACTOR: Thompson Drilling Company (Adelaide)
RIG: 'Mayhew 1000'
METHOD: Rotary-mud
DRILL BIT: 12 cm blade

GEOPHYSICAL LOGGING

	HOLE No.	DATE LOGGED	DEPTH DRILLED m	DEPTH LOGGED m	GEOPHYSICAL LOGS								
					PROBE 9055A-56					PROBE 9032C-901			
					Gamma	S.P.	Res.	Neutron	Deviation	Gamma	Res.	Caliper	Density
EL938-FARINA	FA1	-	12	loose scree in first 6 m prevented logging									
	FA2	23/5/82	84	84.7	X	X	X	X	X	X	X	X	X
	FA3	-	12	loose scree in first 6 m prevented logging									
	FA4	23/5/82	46	46.5	X	X	X	X	X	X	X	X	X
	FA5	24/5/82	36	36.4	X	X	X	X	X	X	X	X	X
LEIGH CK. AREA	LC1	-	24	loose gravel in first 6 m prevented logging									
	LC2	-	8	loose scree prevented logging									
	LC3	25/5/82	18	18.4	X	X	X	X	X	X	X	X	X
	LC4	-	18	loose gravel in first 6 m prevented logging									
	LC5	-	14	loose gravel prevented logging									
	LC6	25/5/82	12	12.1	X	X	X	X	X	X	X	X	X

CONTRACTOR: Century Geophysical Corporation of Australia
UNIT: 8038 longvan
OPERATOR: CREW/NOVAK
BOREHOLE DETAILS: bit size - 12 cm
borehole medium = mud/saline water
borehole reference = ground level
PROBE DETAILS: No. 9055A-56 logging speed, 18m/minute
No. 9032C-901 " " 9m/minute
Density - medium spaced (20 cm)
- source strength (125 mCi)
See log header sheets for more detail.

CONCLUSIONS

The gravity investigations and exploration coal drilling conducted in the Leigh Creek-Farina area were unsuccessful in finding coal or Traissic sediments.

Boreholes were sited on negative bouguer anomalies with magnitudes of between 1 and 3 milligals, which were interpreted as indicating Triassic sediment-filled depressions in the Adelaidean bedrock with potential for economic coal deposits.

The results of the current drilling programme has revealed that the negative bouguer anomalies were caused by the following:

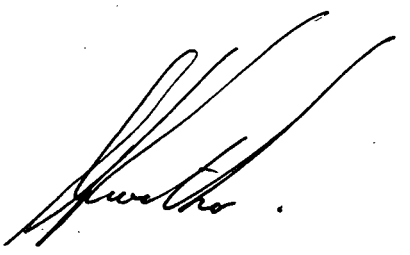
1. bedrock depressions filled with either unconsolidated Quaternary or Tertiary sediment,
2. deeply weathered bedrock,
3. marked changes in bedrock lithology.

Several anomalies may have been caused by a combination of all the above-mentioned causes.

Despite these various alternative causes for negative bouguer gravity anomalies, the gravity method is probably still the most practical method of indirect coal exploration when extensive areas are to be explored for small targets like Leigh Creek type Triassic coal basins.

The earlier gravity programmes used a grid spacing of between 700 to 900 m which is probably too large to adequately define small coal basins the size of Lobe D. However, it would be impractical to recommend that extensive areas covered by previous gravity programmes be re-surveyed at a closer grid unless there was additional evidence to suggest the occurrence of a concealed Triassic basin.

Based on the geophysical and geological data available to date, the prospective area in EL 938 has been adequately explored and no further work is warranted.



GK/GU

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APPENDIX I

Borehole Geological Logs

BOREHOLE GEOLOGICAL LOG

BOREHOLE N° FA 1

PROJECT: FARINA (Exploration Licence No. 938)

Co-ordinates: Lat. 30° 7' 50"
Long. 138° 6' 48"

Tom Hill Gravity Grid
Co-ordinate: 13.S.14

Total Depth: 12 m.

Drilling Company: Thompson Drilling Co. Pty. Ltd.

Date Drilled: 22/5/82

Rig : "Mayhew 1000"

Logged by: G. Kwitko

Method : rotary-mud.

DEPTH (metres) From	To	CUTTINGS DESCRIPTION
0	2	SILTY CLAY & GRAVEL: angular and sub-rounded pebbles and cobbles of quartzite, vein quartz, and silcrete and ironstone fragments in a red-brown, silty, sandy clay matrix. Minor yellow-brown gypsum.
2	6	GRAVEL & CLAY: scattered, irregular fragments of weathered quartzite, quartz, ironstone and purple and olive-green shale in an off-white (limonite stained) clay matrix
6	12	QUARTZITE (silicified/cemented fine-medium grained sandstone): yellow-brown and red-brown, weathered, minor vughs with limonitic and ferruginous staining. (hard to very hard drilling).

Interpreted Stratigraphy 0 to 6 m - Recent (scree/alluvial outwash)

6 to 12m - Adelaidean: Myrtle Springs Formation (feldspathic quartzite or orthoquartzite member) OR Copley Quartzite

BOREHOLE GEOLOGICAL LOG

BOREHOLE N° FA 2

PROJECT: Farina (Exploration Licence No. 938)

Co-ordinates: Lat. 30° 9' 20" Tom Hill Gravity Grid
Long. 138° 10' 26" Co-ordinate: 25.S.9.4

Total Depth: 84 m. Drilling Company: Thompson Drilling Co. Pty. Ltd.

Date Drilled: 23/5/82 Rig : "Mayhew 1000"

Logged by: G. Kwitko Method : rotary-mud.

DEPTH (metres) From	To	CUTTINGS DESCRIPTION
0	1	SILTY CLAY: light brown (lake sediment)
1	4	CLAY: light olive-green, soft, minor red/purple (weathered/oxidized) siltstone fragments. 1%-5% angular quartz (vein) fragments. Rare gypsum.
4	42	CLAYEY SILT/SILTY CLAY (weathered siltstone/shale): Interbedded clayey silt and silty clay. Light olive-green to cream, soft. Minor scattered fragments of moderately indurated siltstone, olive-green, very fine grained sandstone and angular fragments of quartz (vein).
42	70	SILTY CLAY (weathered shale): light grey minor light green grey , soft, becoming more indurated with depth. Minor scattered angular quartz (vein) fragments.
70	84	SILTSTONE/SHALE (slightly weathered): light grey, slight increase in induration, moderately indurated siltstone fragments abundant. Harder drilling in bottom 3 metres.

Interpreted Stratigraphy 0 to 1 m - Recent
1 to 84 m - Adelaidean, Myrtle Springs Formation.

BOREHOLE GEOLOGICAL LOG

BOREHOLE N° FA 3

PROJECT: Farina (Exploration Licence No. 938).

Co-ordinates: Lat. 30° 8' 5"
Long. 138° 2' 19"

Total Depth: 12 m.
Date Drilled: 23/5/82
Logged by: G. Kwitko

Drilling Company: Thompson Drilling Co. Pty. Ltd.
Rig : "Mayhew 1000"
Method : rotary-mud.

DEPTH (metres) From	To	CUTTINGS DESCRIPTION
0	4	SILTY CLAY & GRAVEL: angular and subrounded fragments of quartzite (pebble-cobble size), silcrete and vein quartz scattered in a red-brown to off-white silty-sandy clay matrix.
4	6	QUARTZITE (silicified sandstone): pink to off-white, fine grained, very well indurated (hard drilling).
6	12	QUARTZITE: off-white, fine grained, (hard drilling). Minor soft, white-off white, silty and sandy clay interbeds.

Interpreted Stratigraphy 0 to 4 m - Recent
4 to 12 m - Adelaidean, Copley Quartzite.

BOREHOLE GEOLOGICAL LOG

BOREHOLE N° FA 4

PROJECT: Farina (Exploration Licence No. 938)

Co-ordinates: Lat. 30° 14' 2"
Long. 138° 6' 26"

Total Depth: 46 m.

Drilling Company: Thompson Drilling Co. Pty. Ltd.

Date Drilled: 23/5/82

Rig : "Mayhew 1000"

Logged by: G. Kwitko

Method : rotary-mud.

DEPTH (metres) From	To	CUTTINGS DESCRIPTION
0	3	SILTY CLAY & GRAVEL: angular quartzite, quartz, silcrete, shale, & iron stone fragments dispersed through a light brown, silty clay. Abundant (20%) gypsum.
3	22	CLAY: soft and puggy, off-white to cream, mottled light green, orange and purple.
22	34	CLAY: as above with interbeds of silty clay and zones of strong limonite and ferruginous (ochre) staining & mottling. Minor well indurated & oxidized fragments of siltstone.
34	44	SILTY CLAY/SILTSTONE/SANDSTONE: a strongly oxidised unit of silty clay with interbeds of indurated ferruginized siltstone and sandstone. Yellow-brown with red (ferruginous) and orange (limonitic) mottling and staining. Variable amounts of indurated (mod. to strong) oxidized siltstone and very fine-fine grained sandstone
44	45	SANDSTONE (silicified): yellow-brown, cemented very fine to fine grained sandstone with interbeds of yellow-brown and red (silicified) siltstone.
45	46	QUARTZITE: green-grey, very fine grained, very well indurated (silicified). Extremely hard, therefore drilling abandoned.

Interpreted Stratigraphy

0 to 3 m - Recent
3 to 34 m - Quaternary, Avondale Clay
34 to 46 m - Tertiary, lateritic profile developed on Adelaidean Copley Quartzite?

BOREHOLE GEOLOGICAL LOG

BOREHOLE N° FA 5

PROJECT: Farina (Exploration Licence No. 938)

Co-ordinates: Lat. 30° 11' 55"
Long. 138° 10' 50"

Tom Hill Gravity Grid
Co-ordinate: 33.S.15

Total Depth: 36 m.

Drilling Company: Thompson Drilling Co. Pty. Ltd.

Date Drilled: 24/5/82

Rig : "Mayhew 1000"

Logged by: G. Kwitko

Method : rotary-mud.

DEPTH (metres) From	To	CUTTINGS DESCRIPTION
0	1	SILTY CLAY (Lake sediment): light brown.
1	2	CLAY: white, soft and puggy. Dispersed brown gypsum (10%) and fine grained sand (10%).
2	14	SANDSTONE (Quartzitic in part): fine to medium grained, white, weak to moderately cemented, trace white clay cement. Minor interbeds of hard quartzite/sandstone and soft, white, silty clay.
14	26	SANDSTONE (50%) CLAY (Weathered Shale) (50%): white-pink, fine to medium grained sandstone with interbeds of soft white sandy clay.
26	28	CLAY (75%) SANDSTONE, (25%): off white, soft, sandy clay with minor moderately indurated sandstone interbeds.
28	36	SANDSTONE (50%) CLAY (50%): off-white, fine-medium grained sandstone (weakly to moderately cemented) with sandy clay or clay interbeds.

Interpreted Stratigraphy 0 to 1 m - Recent
1 to 36 m - Adelaidean, Copley Quartzite.

BOREHOLE GEOLOGICAL LOG

BOREHOLE N° LC1

PROJECT: Leigh Creek Area

Co-ordinates: Lat. 30° 27' 42"
Long. 138° 21' 39"

Total Depth: 24 m.

Drilling Company: Thompson Drilling Co. Pty. Ltd.

Rig : "Mayhew 1000"

Method : rotary-mud.

Date Drilled: 25/5/82

Logged by: G. Kwitko

DEPTH (metres) From	To	CUTTINGS DESCRIPTION
0	1	SILTY CLAY AND GRAVEL: angular fragments of; red and green shale, white and pink quartzite and dolomite dispersed through a light brown calcareous, silty clay.
1	12	GRAVEL: subrounded and rounded pebbles and cobbles of shale, quartzite and dolomite in orange-brown and cream, soft, silty, sand-clay matrix. Slightly calcareous and minor gypsum. Sandy clay matrix predominates at base.
12	18	DOLOMITE (weathered): yellow-brown, moderately to well indurated, silty calcarenite and dolomite. Minor interbeds of soft, silty, sandy clay. Strongly calcareous.
18	24	DOLOMITE (slightly weathered): olive-green and light yellow-brown, very fine to fine grained calcarenite interbedded with massive dolomite. Very well indurated.

Interpreted Stratigraphy

0 to 1 m - Recent
1 to 12 m - Quaternary, Telford Gravel
12 to 24 m - Adelaidean, Balcanoona Formation.

BOREHOLE GEOLOGICAL LOG

BOREHOLE N° LC 2

PROJECT: Leigh Creek Area

Co-ordinates: Lat. 30° 27' 11"
Long. 138° 21' 31"

Total Depth: 8 m.

Drilling Company: Thompson Drilling Co. Pty. Ltd.

Rig : "Mayhew 1000"

Method : rotary-mud.

Date Drilled: 25/5/82

Logged by: G. Kwitko

DEPTH (metres) From	To	CUTTINGS DESCRIPTION
0	4	SILTY CLAY & GRAVEL: angular and subrounded rock fragments scattered through a light-brown, calcareous silty clay. (soil and alluvial out wash)
4	8	DOLOMITE (weathered): off-white and pink, very fine grained, calc-arenite and silty, dolomitic limestone. Very well indurated (extremely hard drilling).

INTERPRETED STRATIGRAPHY 0 to 4 m - Recent
4 to 8 m - Adelaidean, Balcanoona Formation.

BOREHOLE GEOLOGICAL LOG

BOREHOLE N° LC 3

PROJECT: Leigh Creek Area

Co-ordinates: Lat. 30° 25' 58"
Long. 138° 20' 22"

Total Depth: 18 m.

Drilling Company: Thompson Drilling Co. Pty. Ltd.

Date Drilled: 25/5/82

Rig : "Mayhew 1000"

Logged by: G. Kwitko

Method : rotary-mud.

DEPTH (metres) From	To	CUTTINGS DESCRIPTION
0	1	SILTY CLAY: light-brown, unconsolidated, minor angular rock fragments.
1	11	SHALE: purple, minor silty shale laminae and limonite stained surfaces. Well indurated.
11	18	SHALE/SILTY SHALE: light and dark green shale with interbeds of silty shale. Minor yellow-green, soft, clay horizons.

Interpreted Stratigraphy 0m to 1 m - Recent
1m to 18 m - Adelaidean, Tapley Hill Formation.

BOREHOLE GEOLOGICAL LOG

BOREHOLE N° LC 4

PROJECT: Leigh Creek Mining Lease

Co-ordinates: Lat. 30° 27' 6"
Long. 138° 22' 16"

Total Depth: 18 m.

Drilling Company: Thompson Drilling Co. Pty. Ltd.

Date Drilled: 25/5/82

Rig : "Mayhew 1000"

Logged by: G. Kwitko

Method : rotary-mud.

DEPTH (metres) From	To	CUTTINGS DESCRIPTION
0	1	SILTY CLAY: light brown with minor scattered angular rock fragments. (shales and quartzite etc.)
1	5	GRAVEL: subrounded and rounded pebbles (0.5 cm to 5 cm) of shale, quartzite and limestone in a light brown slightly calcareous, silty, sandy clay matrix.
5	8	SILTY CLAY (weathered Shale/Siltstone): yellow-orange, soft, silty clay.
8	14	SILTSTONE/SHALE: yellow-brown and light brown, mod. to well indurated, inter-bedded siltstone and shale. Minor (10%) yellow-brown clay, slightly calcareous.
14	18	SILTSTONE/SHALE: light green-grey to yellow-brown. Well indurated.

Interpreted Stratigraphy

0 to 1 m - Recent
1 to 5 m - Quaternary, Telford Gravel
5 to 18m - Adelaidean, Amberoona Formation (?)

BOREHOLE GEOLOGICAL LOG

BOREHOLE N° LC 5

PROJECT: Leigh Creek Mining Lease

Co-ordinates: Lat. 30° 25' 49"
Long. 138° 22' 22"

Total Depth: 14 m.

Drilling Company: Thompson Drilling Co. Pty. Ltd.

Date Drilled: 25/5/82

Rig : "Mayhew 1000"

Logged by: G. Kwitko

Method : rotary-mud.

DEPTH (metres) From	To	CUTTINGS DESCRIPTION
0	1	SILTY CLAY: light brown, few scattered angular rock fragments. (Leigh Creek Alluvium).
1	2	GRAVEL: poorly sorted angular to rounded rock fragments in a slightly calcareous silty clay matrix.
2	2.5	CONGLOMERATE: Very hard, well indurated, $CaCO_3$ cemented conglomerate.
2.5	6	SILTY CLAY (weathered siltstone): yellow-brown and soft.
6	14	SILTSTONE: red to yellow-brown, slightly calcareous and well indurated (hard drilling).

Interpreted Stratigraphy 0 to 1 m - Recent
1 to 2.5 m - Quaternary, Telford Gravel
2.5 to 14 m - Adelaidean, Angepena Formation (?)

BOREHOLE GEOLOGICAL LOG

BOREHOLE N° LC 6

PROJECT: Leigh Creek Mining Lease

Co-ordinates: Lat. 30° 26' 52"
Long. 138° 22' 57"

Total Depth: 12 m.

Date Drilled: 25/5/82

Logged by: G. Kwitko

Drilling Company: Thompson Drilling Co. Pty. Ltd.

Rig : "Mayhew 1000"

Method : rotary-mud.

DEPTH (metres) From	To	CUTTINGS DESCRIPTION
0	1	SILTY CLAY: light brown (Leigh Creek Alluvium).
1	2	GRAVEL: poorly sorted, angular to rounded pebbles (up to 3 cm) of shale, quartzite and dolomite in a yellow-brown silty clay (calcareous) matrix.
2	8	SHALE (weathered): yellow-brown, moderately indurated.
8	12	SHALE: light green-grey, mod. to well indurated.

Interpreted Stratigraphy
0 to 1 m - Recent
1 to 2 m - Quaternary, Telford Gravel
2 to 12 m - Adelaidean, Angepena Formation (?)

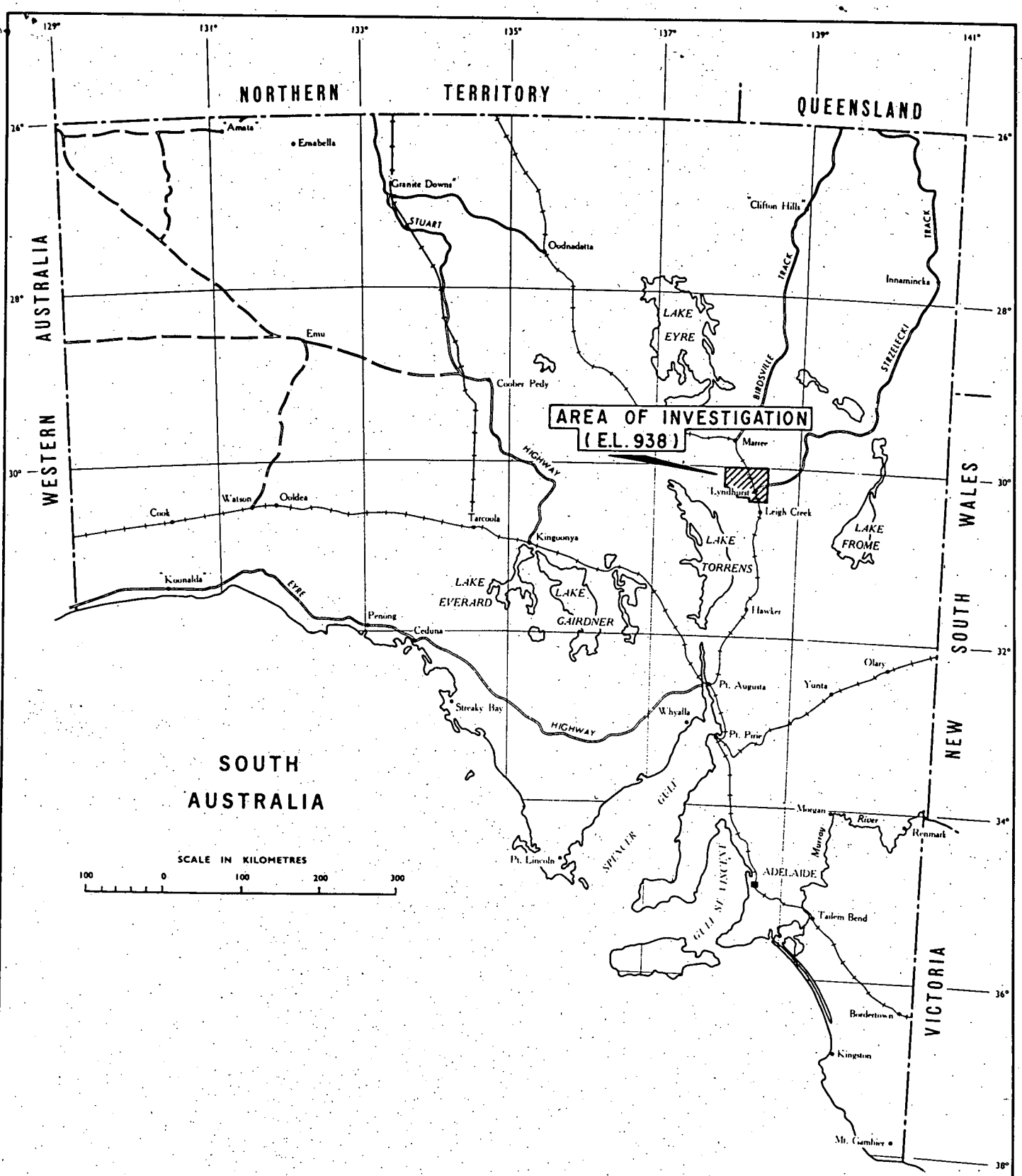


FIG. 1

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

LEIGH CREEK - FARINA COAL EXPLORATION, E.L.938

LOCALITY PLAN

COMPILED G. Kwitko	C D O DATE
DRAWN R. H.	SCALE As shown
DATE Nov. 1982	PLAN NUMBER S 16483
CHECKED	

3080

P.F. No 55850 9942

137°40' 138°00' 138°30' 139°00'

29°45' 29°45'

30°00' 30°00'

30°30' 30°30'

30°50' 30°50'

137°40' 138°00' 138°30' 139°00'

Marree 12 km

NARROW GAUGE RAILWAY (DISUSED)

COMMONWEALTH RAILWAY

'Wilpoorinna'

'Witchelina'

FARINA

Tom Hill

TOM HILL SURVEY 1982

Minagoona Lake

AVONDALE SURVEY 1980

'Avondale'

Mt. Lyndhurst

LAKE WATHERSTON SURVEY 1961

Lake Watherston

BMR / SADME SURVEYS 1947 — 1952

LYNDHURST

LOBE D

LOBE C

'Myrtle Springs'

LEIGH CREEK SURVEY PEGUM, 1962

LEIGH CREEK

LOBE B

BMR/SADME SURVEYS 1947-1952

NOR — WEST FAULT

Mt. Jefferey

LOBE A

COPLEY

LEIGH CREEK SOUTH

BELTANA

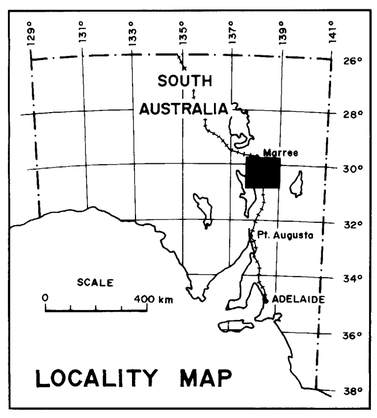
LEGEND

- QUATERNARY & TERTIARY SEDIMENTS
- JURASSIC SEDIMENTS
- TRIASSIC COAL BASIN
- PRECAMBRIAN OUTCROP

FOLD AXES

- Syncline
- Anticline

- FAULT
- E.T.S.A. Exploration Licence No. 938
- E.T.S.A. Mining Lease
- Gravity Survey Area



SCALE IN KILOMETRES

5 0 5 10 15 20 25

Geology based on COPLEY, MARREE, CURDIMURKA and ANDAMOOKA 1:250 000 State Geological Maps (S.A. Department of Mines and Energy)

FIG. 2

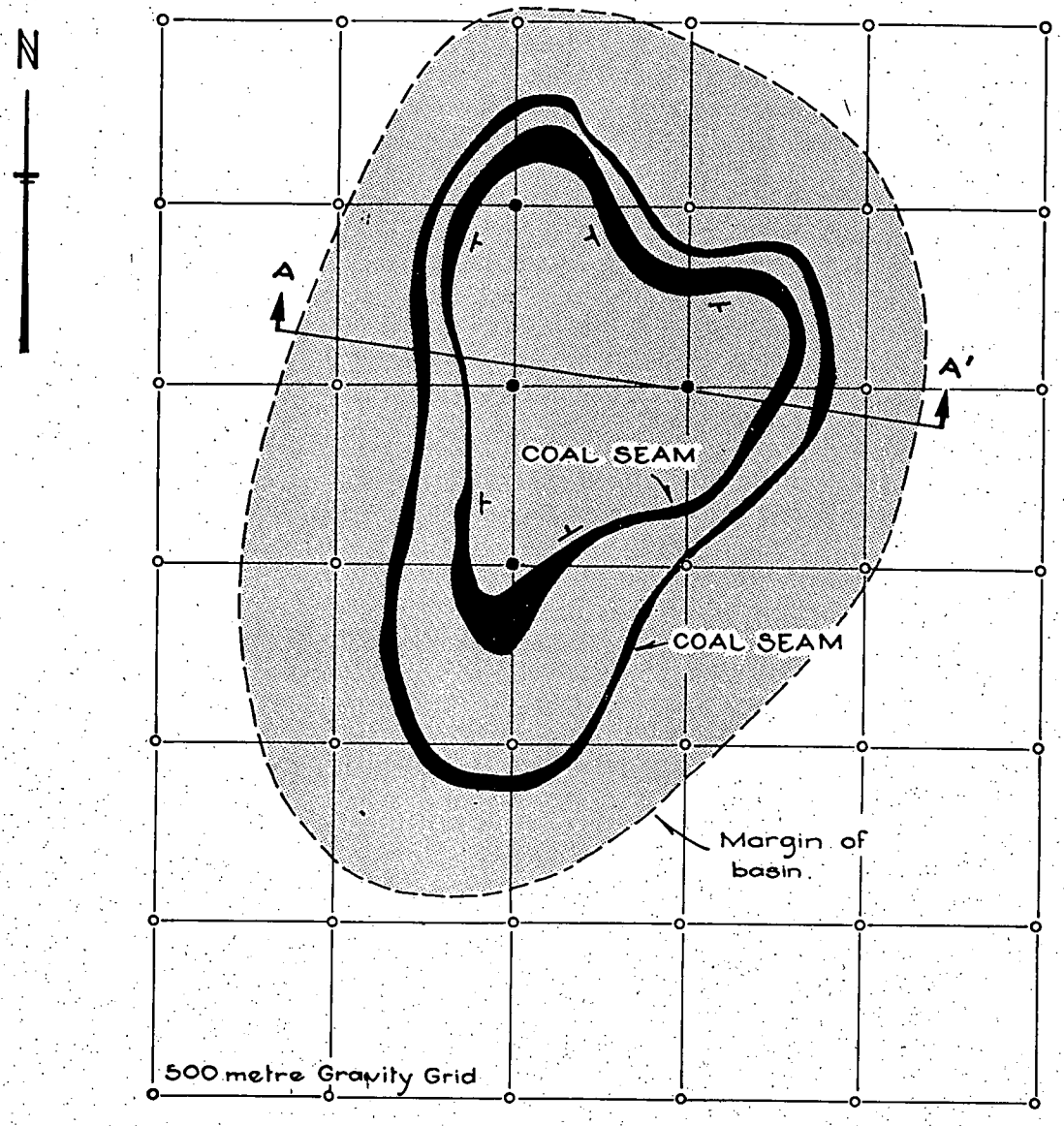
DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA

LEIGH CREEK-FARINA COAL EXPLORATION, E.L. 938
GENERALISED GEOLOGY AND LOCATION OF GRAVITY SURVEYS

COMPILED	G. K.
DRAWN	N. S.
DATE	NOV. 1982
CHECKED	
C.D.O.	19.4.83 DATE
SCALE	1:250 000
PLAN NUMBER	82-601

3030

LOBE D COAL BASIN - MINIMUM SIZE TARGET FOR THE 1981 - 1982 COAL EXPLORATION PROGRAMME ON E.L. 983.



● ..... Station with a gravity anomaly of at least 2 milligals.

SCALE
500 metres

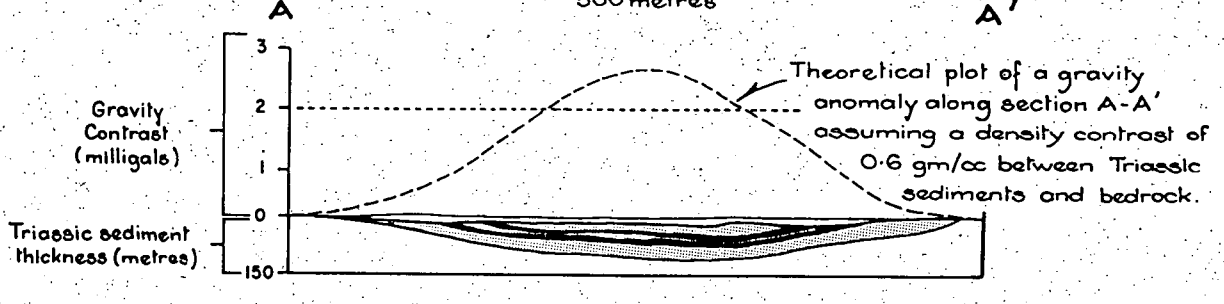


Fig. 3

DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	COMPILED G. K.	C.D O. DATE
LEIGH CREEK COAL FIELD LOBE D BASIN PLAN AND SECTION WITH SUPERIMPOSED 500 METRE GRAVITY GRID	DRAWN M. R.	SCALE As shown
	DATE July 1981	PLAN NUMBER S 15882
	CHECKED	

2548

Witchelina

Farina

Rocky Dam

*TOM HILL

Minagoona Dam

MINAGOONA LAKE

Swamp Twin Dams

PORT AUGUSTA – MARREE RAILWAY

BOUNDARY

GRID

AMG COORDINATES ZONE 54
E 222602·91
N 6672392·61

AMG COORDINATES ZONE 54
E 238881·83
N 6656131·67

139°15'

30°10'

INDEX TO 1:50 000 SHEETS

SURVEY GRID LOCATION	
WITCHELINA 6537 - IV	FARINA 6537 - I
MYRTLE 6537 - III	TELFORD 6537 - II

REFERENCE

Field grid coordinate	27–S17
Grid point with a wooden peg	•
Grid point with a steel peg and field identification number	×152
Main road	
Track	
Railway	
Building	•
Grid point and line number	×44

SCALE

METRES 1000 0 1 2 3 4 5 KILOMETRES

FIG. 4

DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	COMPILED G.K.	19·4·83 C.D.O	DATE
LEIGH CREEK - FARINA COAL EXPLORATION, E.L. 938	DRAWN E. CALABIO	SCALE 1:50 000	
TOM HILL GRAVITY SURVEY	DATE NOV. 1982	PLAN NUMBER 82-602	
	CHECKED		

3030

138°00'
30°00'
138°15'
138°30'
30°15'
30°30'

Marree 45km

Witchelina
South Well Dam
Farina
TOM HILL
Minnagoona Dam
New Rocky Dam
Rocky Dam
MINAGOONA LAKE
Swamp Twin Dam
St Abecket Well
Richardson Dam
New Year Dam
TERMINATION HILL
LAKE WATHERSTON
IDEYAKA HILL
Pug Hut
Tin Hut Dam
Red Hill Ddmb
Lyndhurst
Yadlakina Bore
MOUNT PLAYFAIR
MOUNT PARRY
Myrtle Springs
Donaldson Dam
Donaldson Tank
Napier Dam
Middle Tank
Yellow Cliff Tank
Mundy Tanks
MOUNT TELFORD
Rochack Dam
Telford
Aerodrome
Stone Hut
Leigh Creek
Copley 6km
Mundy Well
North Punchs Bore
Punchs Rest Well
Avondale
Mt Lyndhurst 18km
TRACK
STRZELECKI
PORT AUGUSTA - MARREE RAILWAY

FA1 FA2 FA3 FA4
GA1 GA2 GA3 GA4 GA5 GA6 GA7 GA8 GA9 GA10 GA11 GA12 GA13 GA14 GA15 GA16 GA17 GA18
AV1 AV2 AV3 AV4 AV5 AV6 AV6A AV7 AV8 AV9 AV10 AV11 AV12 AV13 AV14
L1 L2 L3 L4
LW1 LW2 LW3,3A
LC1 LC2 LC3 LC4 LC5 LC6
N1 N2 NW1

0066 0072 2301 2305 2335 2401 2402 2403 2404 2405 2406 2407 2408 2410 2411 2412 2413 2319 0441

INDEX TO 1:50000 SHEETS

WITCHELINA 6537-IV	FARINA 6537-I
MYRTLE 6537-III	TELFORD 6537-II

Quaternary and Tertiary sediments.

Triassic coal basin.

Adelaidean outcrop.

Note: Outcrop boundaries are taken from Copley 1:250000 Farina 1:63360 and Myrtle 1:63360 geological map sheets.

Exploration Licence 938

ETSA Leigh Creek coalfield lease

Gravity station

Bouguer gravity contour in milligals (contour interval 1 milligal)

Water bore (SADME bore file 6537-)

Coal exploration bore hole

Diamond exploration bore hole

Note: The Tom Hill, Lake Watherston and Avondale gravity surveys are not matched with the earlier BMR surveys.

SCALE

METRES 1000 0 1 2 3 4 5 KILOMETRES

Fig. 5

DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA

LEIGH CREEK – FARINA COAL EXPLORATION EL 938 BOUGUER GRAVITY CONTOURS AND BORE HOLE LOCATIONS

COMPILED G. KWITKO
DRAWN A.F.
DATE 5-12-82
CHECKED
DATE 19-4-83
SCALE 1:100000
PLAN NUMBER 82-87