DEPARTMENT OF MINES
SOUTH AUSTRALIA

GEOLOGICAL SURVEY
EXPLORATION SERVICES DIVISION

CURNAMONA GRAVITY SURVEY, 1972

S.M.L.'s 543 and 544

CURNAMONA 1:250 000 sheet area

Client: Pacminex Pty. Ltd.

by

R.G. NELSON
GEOPHYSICIST

and

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FIELD ASSISTANT

3rd August, 1972.

Rept.Bk.No. 72/145
G.S. No. 4911
D.M. No. ~~288/62~~ 378/72

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S9919	Location of S.M.L.'s 543 and 544.	As shown.
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72-615	Interpreted depth to Cambrian bedrock.	1" = 2 miles.
S9930/1	Base network and loop closures.	Diagrammatic.

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ABSTRACT

Drilling in the Frome Downs - Curnamona area in S.M.L's 543 and 544 has proved the value of gravity and electrical resistivity methods in locating palaeo-valleys. The Curnamona gravity survey for 1972 was designed to trace further the pre-Tertiary topography which bears a close relationship to radioactive-rich horizons.

INTRODUCTION

In 1971 geophysical traverses were made over two lines in S.M.L.'s 543 and 544 for Pacminex Pty. Ltd. These leases were formerly held by E.A. Rudd Pty. Ltd. as S.M.L.'s 267 and 268. Drg. No. S9919 shows their location.

The object of the geophysical work was to define bedrock relief, the bedrock in this case being the pre-Tertiary surface of probable Middle to Upper? Cambrian age. Previously drilling had shown a relationship between concentrations of radioactive material and the lower part of the Tertiary sequence (sands and carbonaceous-pyritic silt) found mainly in palaeo-valleys.

Ground magnetic work conducted along the test traverses proved unsuccessful, most of the variation coming apparently from deep-seated crystalline basement. However, correlation between electrical resistivity and gravity results was high and several bedrock depressions were indicated. For a complete discussion of this work refer to the appropriate report (Nelson, 1971).

Subsequent drilling between holes E.A.R. 10 and 11 (see Drg. No. 72-615) confirmed the geophysical interpretation and showed the ability of gravity and electrical resistivity methods to delineate bedrock depressions in the area.

Because it was felt that the gravity method was simpler and cheaper than electrical methods, it was chosen for traverses to be made in the 1972 field season. Eight traverse lines were chosen to test other areas in the leases (see Drg. No. 72-615). As far as possible these were designed so as to pass through existing drillholes where Cambrian bedrock had been intersected. This was in order to get a good estimate of regional gravity variations along each line as a knowledge of these is essential for accurate depth interpretation.

The work was carried out during April-June, 1972 by G.T. Galbraith, field assistant. Survey lines were optically pegged and levelled by S.C. Wills, Survey Assistant, Grade II (see Wills, 1972).

REGIONAL GEOLOGY

The area investigated lies in the southern part of the Lake Frome embayment in an area of low relief bounded by the Flinders Ranges in the west, the Broken Hill block in the east and the Olary block to the south. Lake Frome itself lies immediately to the north of the leases.

The embayment is filled with a thick sequence (in excess of 5 000 m) of sedimentary rocks of Precambrian and Cambrian age. Overlying these rocks is a thin veneer of sediments of Permian, Mesozoic, Tertiary or Quaternary age.

PREVIOUS GEOPHYSICAL WORK

The Lake Frome embayment has been covered quite extensively by various geophysical surveys, including gravity, seismic and aeromagnetic work.

Method	Year	Remarks
Seismic	1964-5-6	by S.A. Dept. of Mines for themselves.
Seismic	1966	Eromanga-Frome seismic and gravity survey by United Geophysical Corporation for Delhi Australian Petroleum Ltd.
Seismic	1970	Frome Downs seismic and gravity survey by Austral United Geophysical Pty. Ltd. for Crusader Oil N.L.
Gravity	1963	Lake Frome gravity survey by G.S.I. for Delhi Australian Petroleum Ltd.
Gravity	1965	Lake Gregory gravity survey by Wongela for Delhi Australian Petroleum Ltd.
Gravity	1966	Eromanga-Frome seismic and gravity survey as above.
Gravity	1970	Frome Downs seismic and gravity survey as above.
Gravity	1971	Curnamona geophysical survey 1971 by S.A. Dept. of Mines for Pacminex Pty. Ltd.

Ground Magnetic	1971	Curnamona geophysical survey 1971 as above.
Aeromagnetic	1962	Flown by Bureau of Mineral Resources. Reduced by South Australian Department of Mines.
Aeromagnetic	1963	by Adastra Hunting for Delhi Australian Petroleum Ltd.
Electrical resistivity	1971	Curnamona geophysical survey 1971 as above.

GRAVITY SURVEY DETAILS

1. Instrument used

Sharpe CG-2 Geodetic Gravity meter serial number 190-G.

Calibration on Adelaide gravity stations 6091.0108 and 6091.0208.

Calibration factor (24.4.72)- 0.1001(25) mgals./div.

Calibration factor (26.6.72)- 0.1001(73) mgals./div.

Claimed reading accuracy = 0.005 mgals.

Claimed repeat accuracy = 0.01 mgals. under field survey conditions.

2. Station and survey line data

Stations pegged at 500 feet spacing on each traverse line and levelled using level and staff.

For further details refer to:

Gravity Survey Traverses in Siccus, Sandyoota, Telechie and Curnamona 1 Mile

by S.C. Wills (1972).

Station numbering - example: '2/75' refers to station number 75 on line 2.

The two geophysical traverses made in 1971 were pegged at 200 feet intervals and are referred to as the 'Coondappie' and 'Ashby' lines respectively. Stations on these lines are referred to by the letters 'C' or 'A' prefixing the station number.

Line 5 in the 1972 survey runs from the end of the Coondappie line to the eastern edge of S.M.L. 543; line 7 continues on from peg A409 on the Ashby line to the eastern edge of S.M.L. 544.

3. Control

Control Base Station

Data in the 1971 survey were referred to gravity station 9258 (latitude 31°30', longitude 139°51.90') used in the 1965 Wongela survey. The gravity value assumed for this station after tying in to the isogal station at Quilpie is 979413.14 mgals.

A more recent value for this station has been produced in the B.M.R. helicopter survey of the CURNAMONA 4-mile sheet (also conducted by Wongela), viz. 979413.92 mgals. This value has been adopted for this survey.

Corrèctions to bring 1971 data in line with 1972 survey.

Station levels on the Ashby and Coondappie lines were rechecked in this survey and were found to be in error by constant quantities.

After consideration the following corrections were adopted to make 1971 station levels consistent with levels used in this survey:

(a) Coondappie line.

All elevations reduced by 2.000 ft.

(b) Ashby line.

All elevations reduced by 3.115 ft.

Using the new value for the control station and these reduced levels means that a constant value of +0.56 mgals. must be added to Bouguer gravity values for the 1971 survey to bring them into line with values used in this survey.

Survey base stations

Base stations were established at key points on each line and tied to the control station by interlooped runs of not more than 2 hours duration. The base network and loop closures are shown in Drg. No. S9930/1. Adjustments were made for zero-loop closure using a least squares method described by Smith (1951), and values for the base stations were calculated with reference to the survey control station.

4. Reduction of data

Tie readings were made at intervals of not more than two hours and generally less than one hour when the intermediate stations between bases were read.

Drift plots were made for all runs and linear drift was assumed between the tie readings.

Latitude corrections were made using the formula for theoretical gravity on the International Ellipsoid with latitudes scaled from 1:50 000 base maps of the area.

A density of 1.9 gms./cc. was used in calculating the elevation factor, giving an elevation factor of 0.069797 mgals./ft.

Because of the general flatness of the terrain, no topographic corrections were made, and the final Bouguer gravity values were calculated in the usual way.

The results are plotted in Drg. Nos. 72-606 to 72-610 as Bouguer gravity profiles for each line. The regional variation of gravity along each line was estimated from borehole data where these were available, assuming a density contrast between sediments and bedrock of -0.8 gms./cc. The method used in estimating the regional is discussed in the 1971 survey report (Nelson, 1971).

The residual gravity after the regional effect has been removed is shown as a profile for each line in Drg. Nos. 72-606 to 72-610.

INTERPRETATION OF DATA

The residual gravity profile is taken as being an estimate of the palaeotopography of the pre-Tertiary surface under each line.

Initial depth estimates have been made using the Bouguer slab formula; these, together with borehole information, provide the basis for the contoured depths to bedrock in Drg. No. 72-615.

Preliminary tests with a computer program designed to calculate depths to basement for a sedimentary basin indicate that the error involved in using the Bouguer slab formula may be slight (possibly 3-4%). However, the greatest source of error must be considered to be in the estimate of the regional gravity for each line, for without accurate knowledge of this depth estimates may be up to hundreds of feet in error. Control is considered to be good where borehole information is plentiful, e.g., near the south-eastern margin of S.M.L. 543. Towards the western ends of the lines traversed where borehole control is not so good, the depths interpreted are more speculative.

A table of probable bedrock depressions and their maximum depths with respect to mean sea level follows:

LINE	PROBABLE BEDROCK DEPRESSION			
	From	To	Maximum depth	At
1	1/48	1/65	-375'	1/56
	*1/100	1/121	-394'	1/114
	1/161	1/181	-286'	1/177
	*1/194	1/206	-320'	1/198
2	2/16	2/63	-190'	1/43
	*2/111	2/171	(-260'	1/150
			(-249'	1/139
3	*3/10	3/76	-220'	3/47
4	*4/140	4/180	-198'	4/154
6	*6/35	6/83	-116'	6/59
7	7/60	7/75	+54'	7/70
	7/85	?	-140'?	7/100
8	8/1	8/30	(-134'	8/12
			(-122'	8/24
	8/45	8/61	-62'	8/55
	8/66	8/72	-65'	8/69
	*8/75	8/95	(-100'	8/89
			(-92'	8/78
	8/120	8/134	(-42'	8/122
			(-36'	8/132
	8/140	8/152	(-30'	8/148
			(-26'	8/143

*Indicates major depression

The existence of troughs on the Ashby and Coondappie lines has already been verified. Where two maximum depths are listed, the results show two minor depressions located within the major depression.

An examination of the drawing of contoured depths to bedrock (Drg. No. 72-615) shows that the channel verified by drilling on the Ashby and Coondappie lines continues in a direction just west of north through lines 6, 4, 3 and 2 after which one speculates that it changes direction towards NNE and the NE corner of S.M.L. 543.

Bedrock depths tend to increase towards the north, as might be expected, since the centre of the Lake Frome embayment lies here. The general trend of deepening bedrock towards the west of the leases may be explained by referring to a paper by Howchin (1931) who postulates that the Siccus River plain was formerly the course of a great river and that the existing plain is now underlain by thick sediments of sand and gravel.

CONCLUSIONS

It appears that the gravity method has again been successful in defining the palaeotopography of the land form which existed in pre-Tertiary times. In particular, the course of a channel which was previously defined by drilling has been charted for a distance of some ten miles.

RGN:JS
3.8.72

R.G. NELSON
GEOPHYSICIST

per D.m.G.

G.T. GALBRAITH
FIELD ASSISTANT

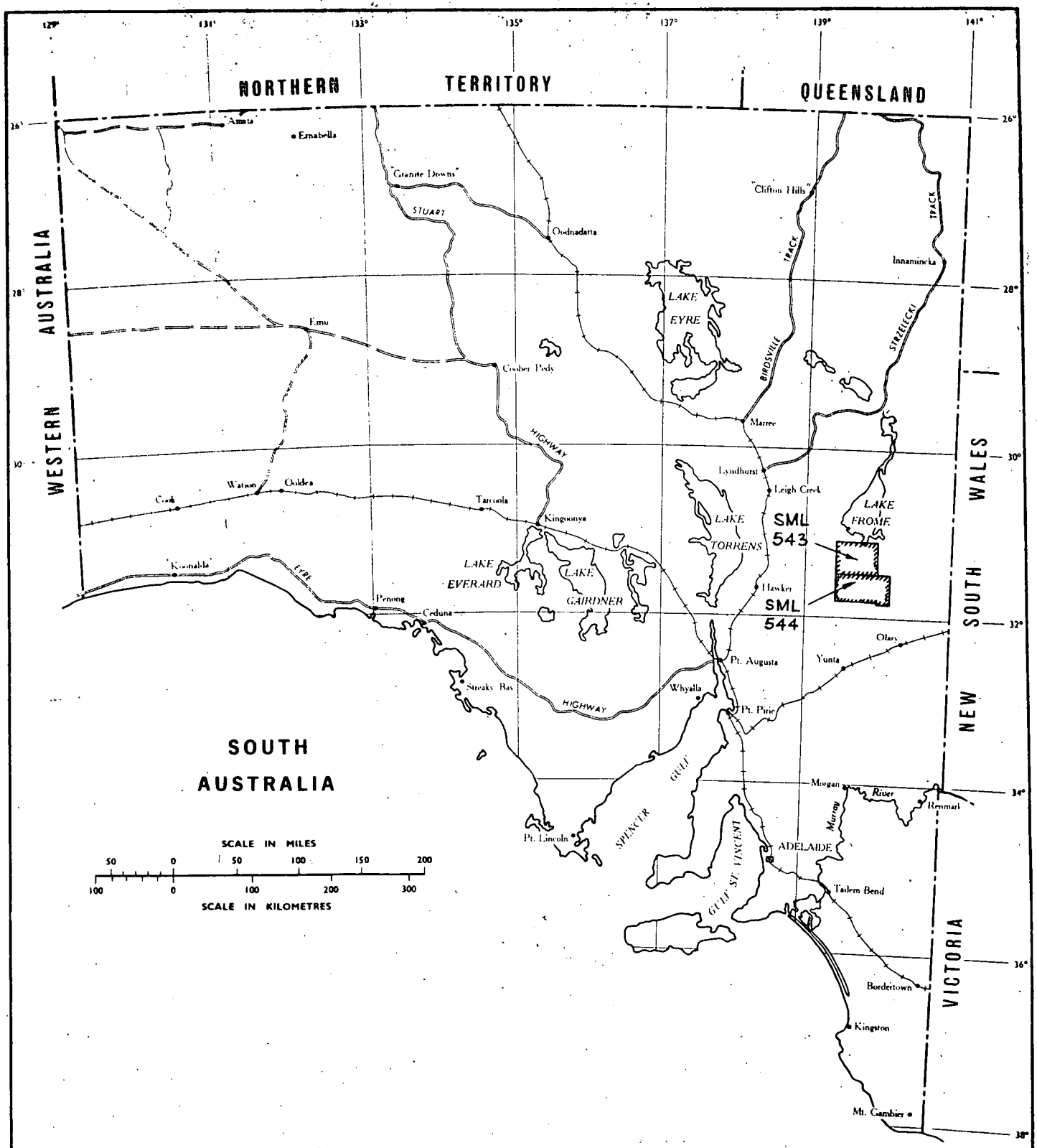
REFERENCES

Howchin, W., 1931. The dead rivers of South Australia. Part I. The western group. Trans. R. Soc. S. Aust., 55: 113-135.

Nelson, R.G., 1971. An experimental survey using geophysical methods to outline bedrock relief. S.M.L.'s 543 and 544. CURNAMONA 1:250 000 sheet area. Dept. Mines unpublished report. R.B.71/122

Wills, S.C., 1972. Gravity survey traverses in Siccus, Sandyoota, Telechie and Curnamona 1 mile. Dept. Mines unpublished report. R.B. 72/129.

Smith, A.E., 1951. Graphic adjustment by least squares. Geophysics, 26: 222-227.

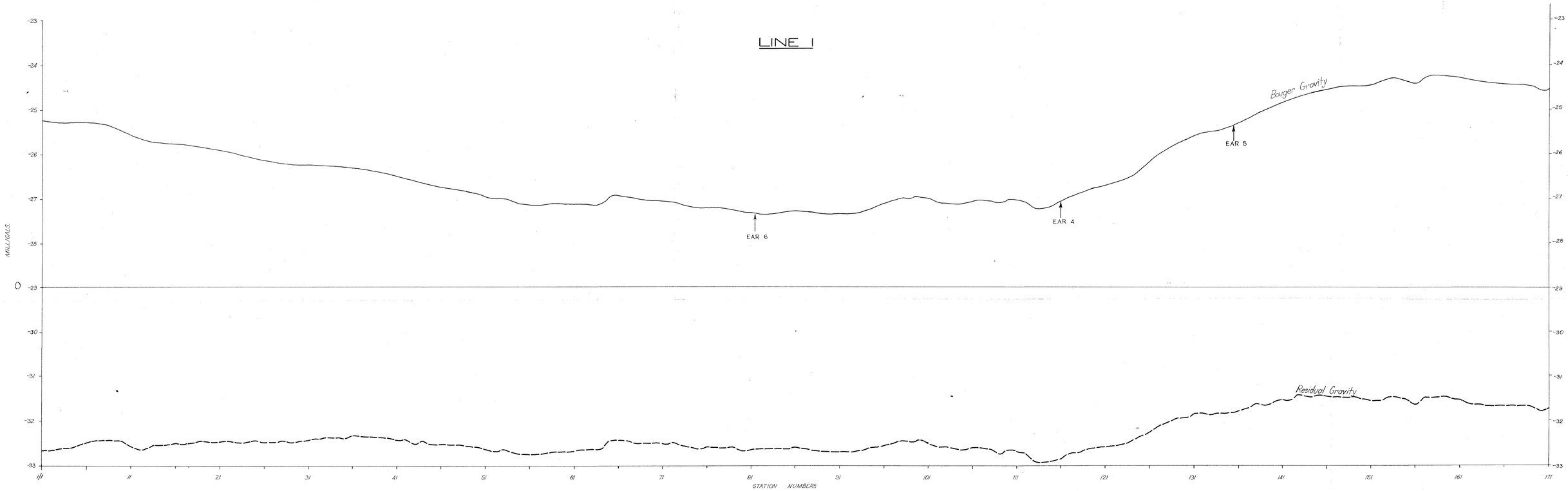


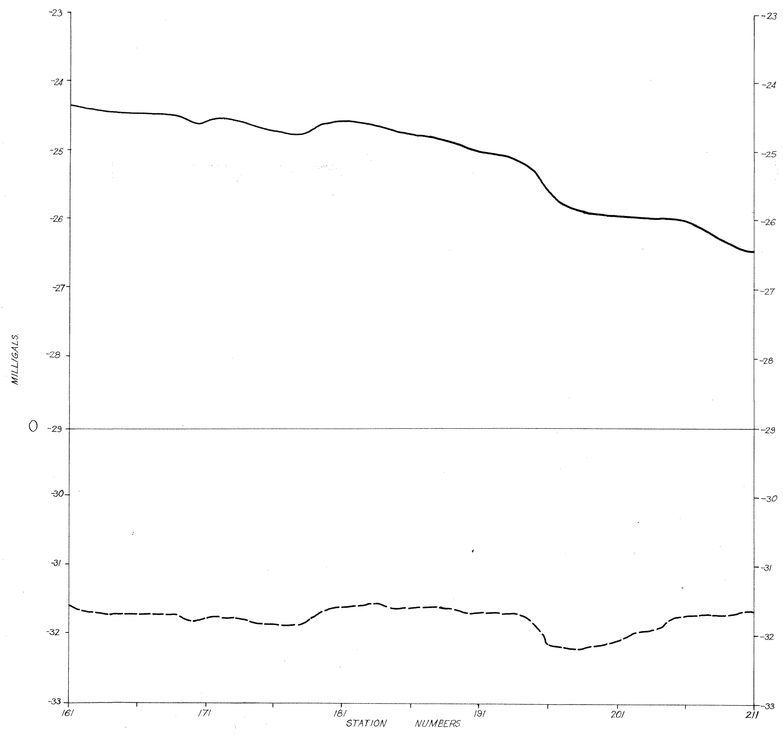
DEPARTMENT OF MINES —— SOUTH AUSTRALIA

Compiled. R. Nelson	CURNAMONA GRAVITY SURVEY 1972	Date: 21st July 1972
Drn. D.J.M. Ckd.	LOCATION OF S.M.L.'S 543 AND 544	Drg. No. S9919 Fl

P.F. No. S5850 994.2

LINE 1





LEGEND

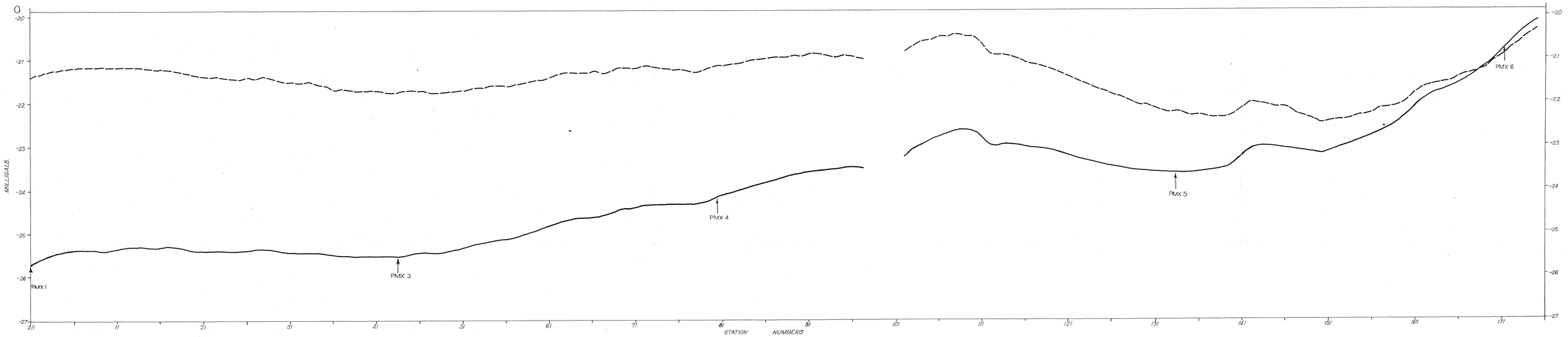
Vertical scale 1 inch reps. 1 milligal.
Horizontal scale 1 inch reps. 2500 ft.
Bouguer gravity profile.
Residual gravity profile.

DEPARTMENT OF MINES — SOUTH AUSTRALIA

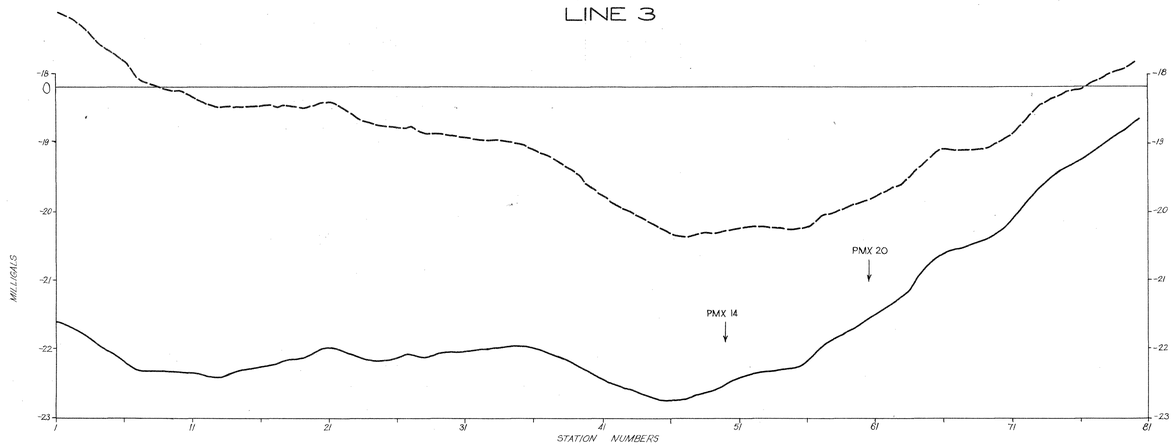
CURNAMONA GRAVITY SURVEY
BOUGUER GRAVITY & RESIDUAL GRAVITY PROFILES
LINE 1

EXPLORATION GEOPHYSICS SECTION	GEOPHYSICIST	Drn. R.N.	SCALE: AS SHOWN
		Tcd. S.J.C.	72-606 Fd.41
Director of Mines		Ckd.	
		Exd.	DATE: 19th JULY 1972

LINE 2



LINE 3



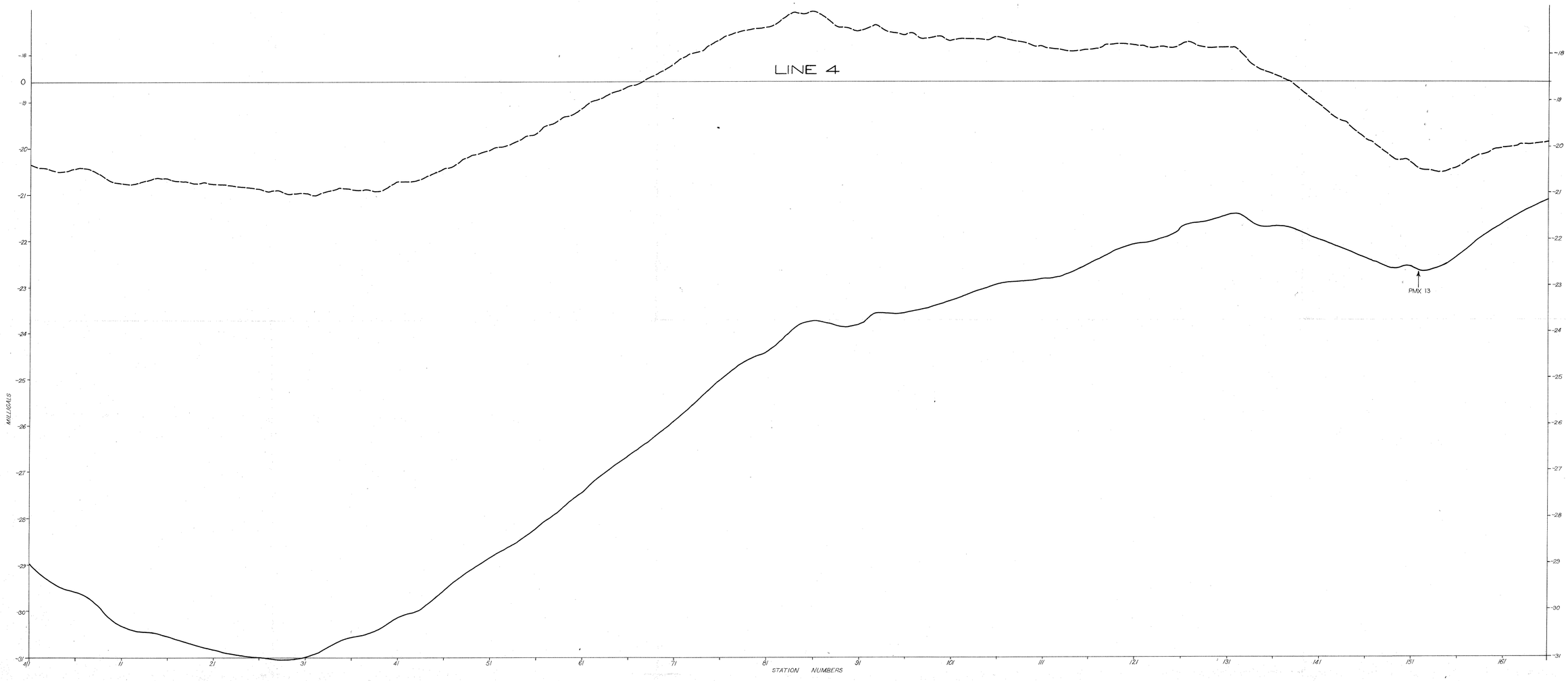
LEGEND
Vertical scale 1 inch reps. 1 milligal.
Horizontal scale 1 inch reps. 2500 ft.
Bouguer gravity profile.
Residual gravity profile.

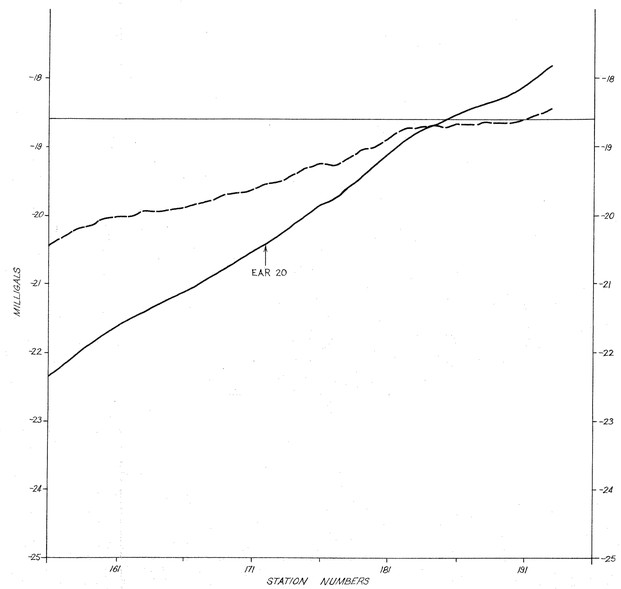
DEPARTMENT OF MINES — SOUTH AUSTRALIA

CURNAMONA GRAVITY SURVEY
BOUGUER GRAVITY & RESIDUAL GRAVITY PROFILES
LINES 2 & 3

EXPLORATION GEOPHYSICS SECTION	GEOPHYSICIST	Drn. R.N.	SCALE: AS SHOWN
		Tcd. S.J.C.	72-607 Fd 1
Director of Mines		Ckd.	
		Exd.	DATE: 19th JULY 1972

LINE 4





LEGEND

Vertical scale 1 inch reps 1 milligal.

Horizontal scale 1 inch reps 2,500 ft.

Bouguer gravity profile.

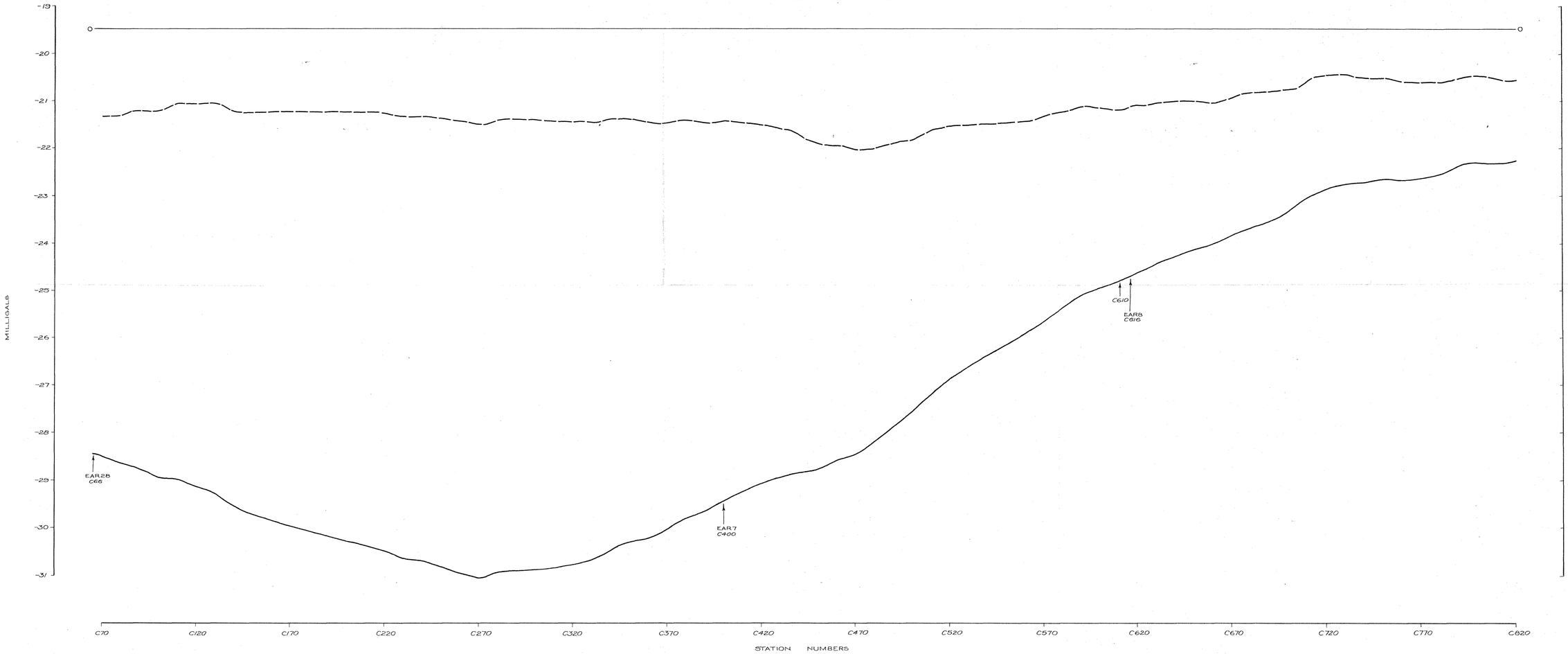
Residual gravity profile.

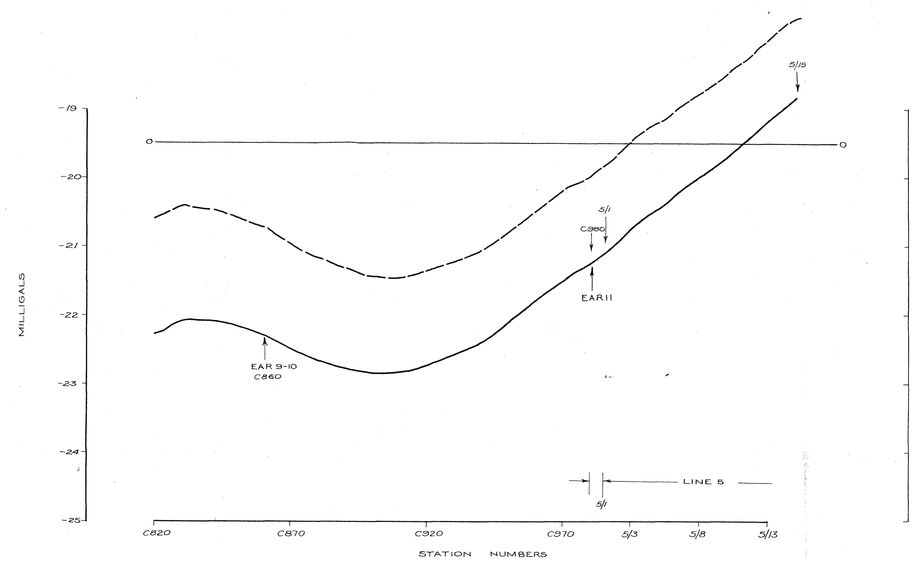
DEPARTMENT OF MINES — SOUTH AUSTRALIA

CURNAMONA GRAVITY SURVEY
BOUGUER GRAVITY & RESIDUAL GRAVITY PROFILES
LINE 4

EXPLORATION GEOPHYSICS SECTION		Drn. R.N.	SCALE: AS SHOWN
	GEOPHYSICIST	Tcd. S.J.C.	72-608 Fd+1
		Ckd.	
Director of Mines		Exd.	DATE: 19th JULY 1972

COONDAPPIE LINE AND LINE 5





LEGEND

Residual Gravity

Bouguer Gravity

Horizontal Scale : 1inch reps. 2,500 feet

Vertical Scale : 1inch reps. 1milligals

DEPARTMENT OF MINES — SOUTH AUSTRALIA

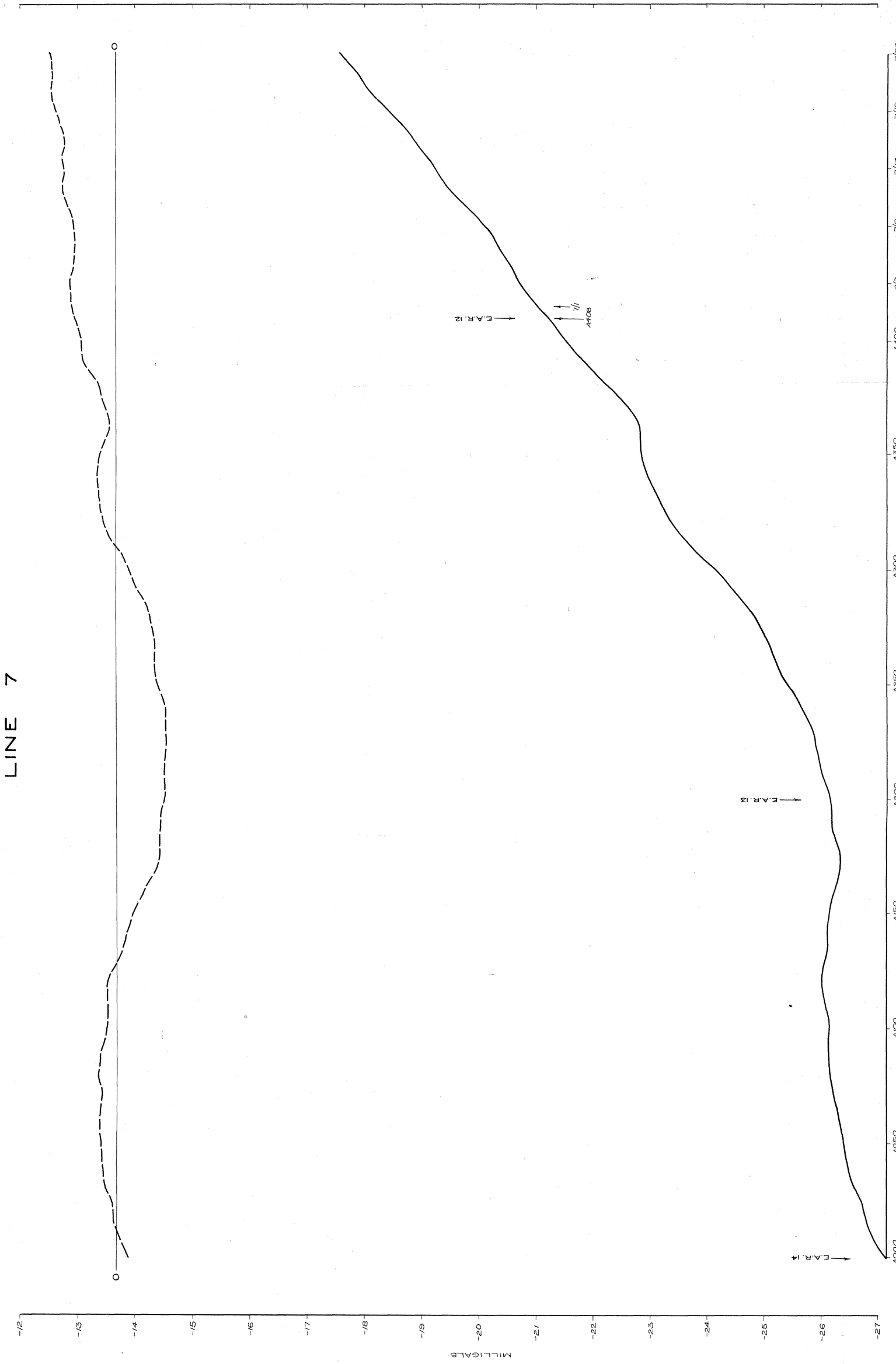
CURNAMONA GRAVITY SURVEY

BOUGUER GRAVITY & RESIDUAL GRAVITY PROFILES

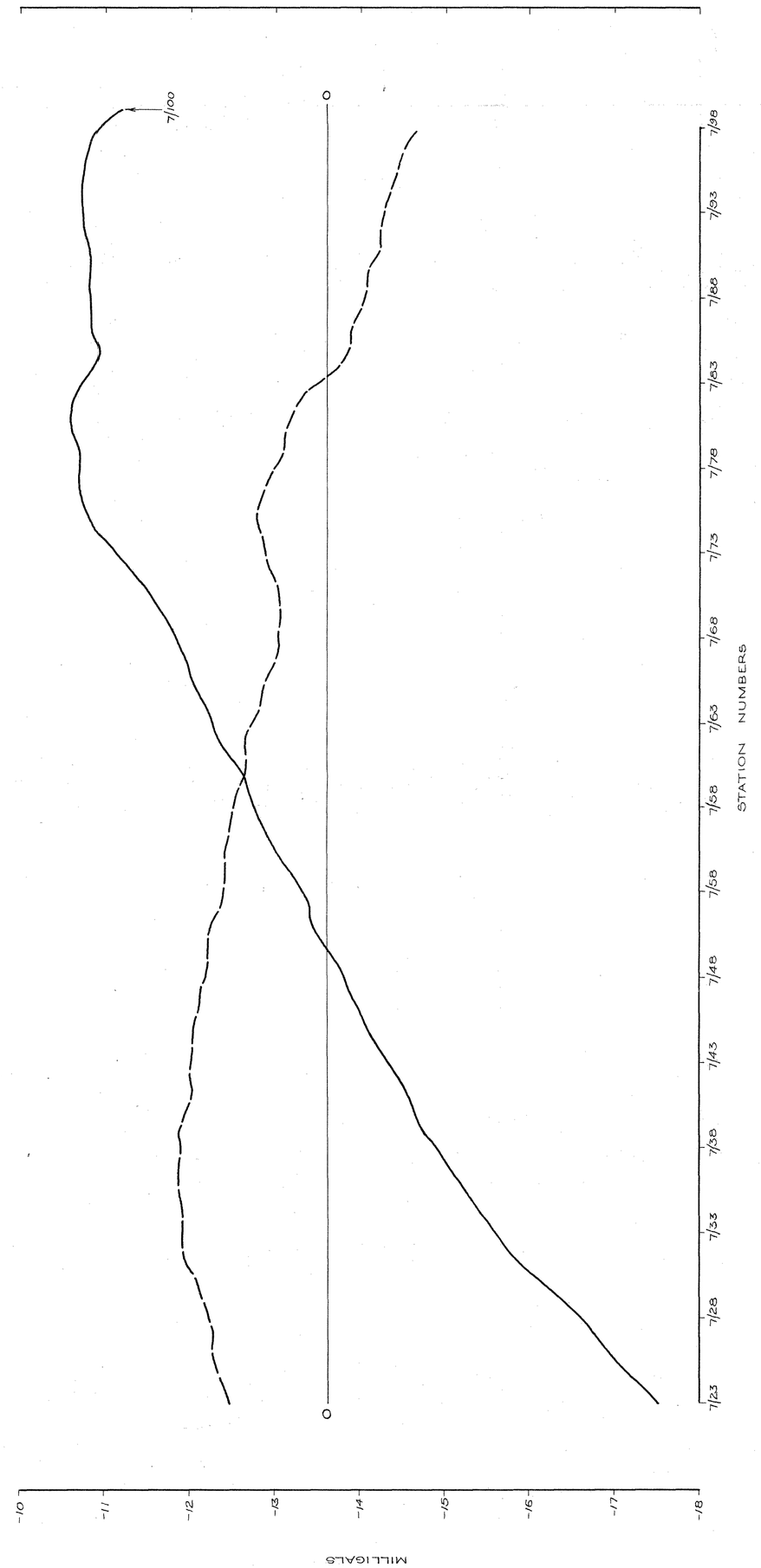
COONDAPPIE LINE AND LINE 5

EXPLORATION GEOPHYSICS SECTION	GEOPHYSICIST	Drn. R.N.	SCALE: AS SHOWN
		Tcd. A.G.R.	72-609 Fd+t
		Ckd.	
Director of Mines	SEN. GEOPHYSICIST	Exd.	DATE: 19 JULY 1972

ASHBY LINE AND LINE 7



ASHBY LINE AND LINE 7



LEGEND

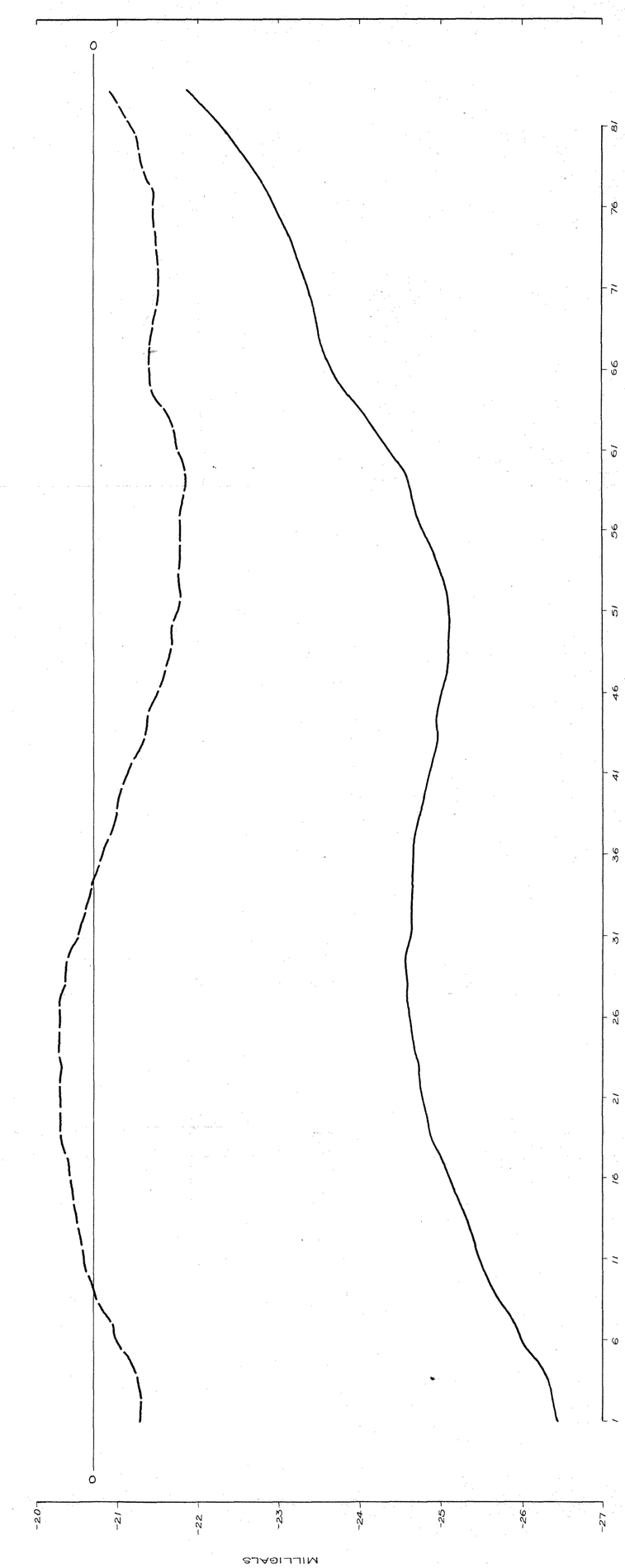
Bouguer Gravity

Residual Gravity

Horizontal Scale : 1 inch reps. 2,500 feet

Vertical Scale : 1 inch reps. 1 milligal

LINE 6



DEPARTMENT OF MINES — SOUTH AUSTRALIA

CURNAMONA GRAVITY SURVEY

BOUGUER GRAVITY & RESIDUAL GRAVITY PROFILES

ASHBY LINE , LINE 7 AND LINE 6

EXPLORATION GEOPHYSICS SECTION		Drn. R.N.	SCALE: AS SHOWN
	GEOPHYSICIST	Tcd. A.G.R.	72-610 Fd+C
		Ckd.	
Director of Mines	SEN GEOPHYSICIST	Exd.	DATE: 19 JULY 1972

LINE 8
W ⟷ E

MILLIGALS

-21
-22
-23
-24
-25
-26
-27
-28
-29
-30
-31
-32
-33
-34
-35
-36
-37
-38
-39
-40
-41
0
42
41

E.A.R 27

E.A.R 19

Bouguer Gravity

Residual Gravity

0

1 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160

STATION NUMBERS

Horizontal Scale : 1inch rep. 2,500 feet

Vertical Scale : 1 inch. rep. 1 milligal

DEPARTMENT OF MINES -- SOUTH AUSTRALIA

CURNAMONA GRAVITY SURVEY
BOUGUER GRAVITY & RESIDUAL GRAVITY PROFILES
LINE 8

EXPLORATION GEOPHYSICS SECTION		Drn. R.N.	SCALE: AS SHOWN
	GEOPHYSICIST	Tcd. A.G.R.	72-611 Fd+L
		Ckd.	
Director of Mines	SEN. GEOPHYICIST	Exd.	DATE: 19 JULY 1972

CURNAMONA GRAVITY SURVEY 1972
INTERPRETED DEPTH TO CAMBRIAN BEDROCK

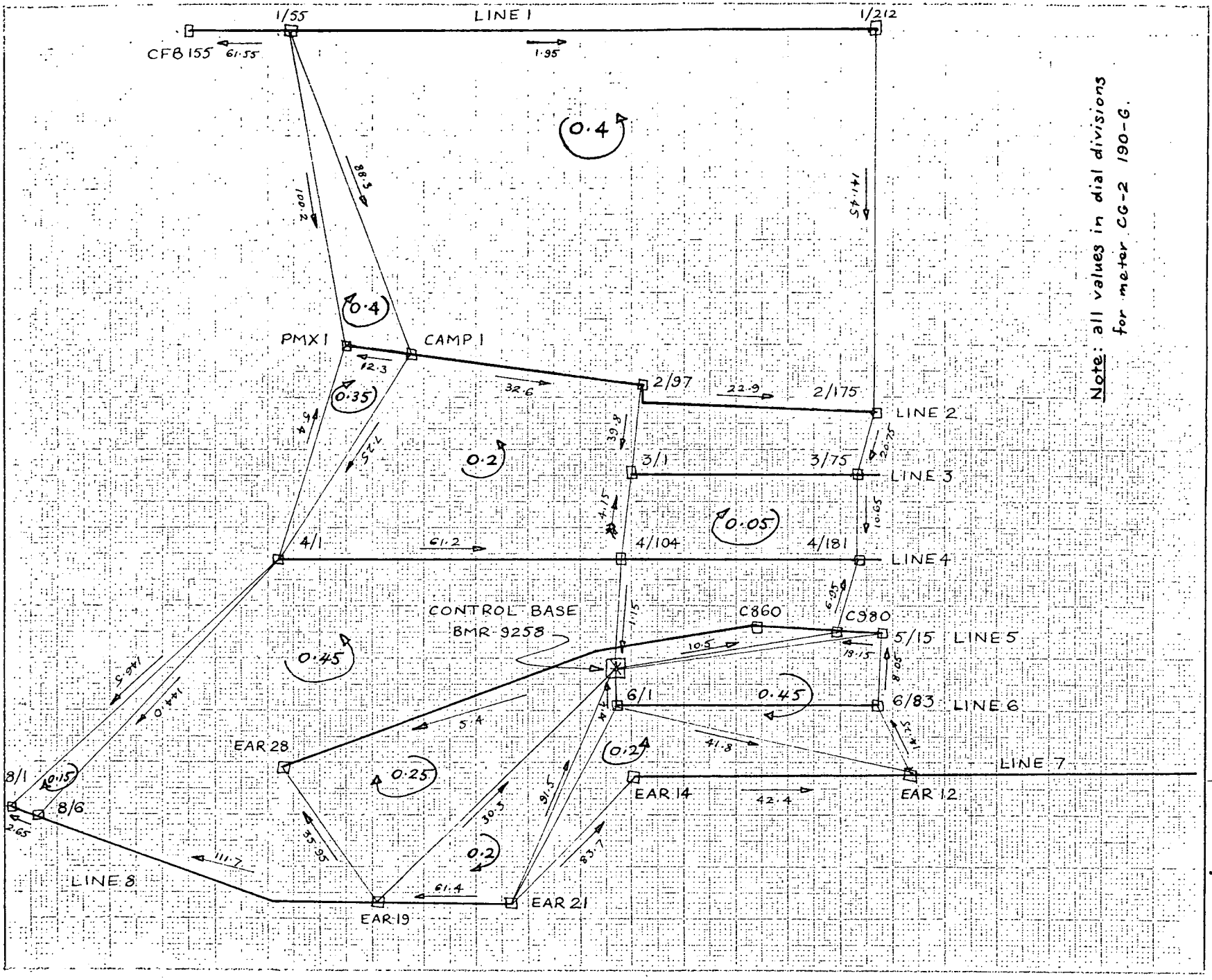
DEPARTMENT OF MINES — SOUTH AUSTRALIA

EXPLORATION GEOPHYSICS SECTION			
Director of Mines			
SEN. GEOPHYSICIST	GEOPHYSICIST	Drn. R.N	SCALE: 1 inch : 2 miles (orig)
Exd.	Ckd.	Tcd. D.J.M	72-615
DATE: 21st July 1972			Fl

SCALE IN KILOMETRES
5 0 5 10 15
2 0 2 4 6 8 10
SCALE IN MILES

LEGEND

- PMX 3 — Pacminex Rotary Drill Hole
- 21 — E.A. Rudd Rotary Drill Hole
- -200 — Interpreted depth to Cambrian bedrock from Gravity Survey (in feet)
- LINE 2 — 1972 Gravity Traverse
- COONDAPPIE, ASHBY LINES — 1971 Gravity Traverse
- CFB — Crusader seismic line
- S.M.L. Boundary
- Track


1/55
LINE 1
1/212
CFB 155
61.55
1.95
0.4
88.5
100.2
141.45
0.4
PMX 1
CAMP 1
12.3
32.6
2/97
22.9
2/175
LINE 2
0.35
9.4
7.25
39.8
20.75
0.2
3/1
3/75
LINE 3
4.15
10.65
0.05
4/1
61.2
4/104
4/181
LINE 4
CONTROL BASE
BMR 9258
C860
C980
6.05
1.15
5/15
LINE 5
10.5
13.15
8.05
0.45
6/1
0.45
6/83
LINE 6
146.5
0.144
5.4
EAR 28
41.8
5.5
LINE 7
8/1
0.15
0.25
0.2
EAR 14
42.4
EAR 12
8/6
2.65
35.95
30.5
91.5
83.7
0.2
111.7
LINE 8
61.4
EAR 19
EAR 21
Note: all values in dial divisions for meter CG-2 190-G.
DEPARTMENT OF MINES — SOUTH AUSTRALIA
CURNAMONA GRAVITY SURVEY 1972
BASE NETWORK & LOOP CLOSURES
Scale: Diag.
Date: 31-7-72
Drg. No. S9930/1 Fd+L
Compiled: R.G.N.
Drn.
Ckd.
IH-2.70 A1810