COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES,
GEOLOGY AND GEOPHYSICS

RECORDS 1956, No. 120

SEISMIC REFRACTION SURVEY AT THE MINGOOLA DAM SITE, DUMARESQ RIVER, N.S.W.

by

E. R. SMITH, M. J. O'CONNOR and E. J. POLAK

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ABSTRACT

Results are given of a geophysical survey carried out on behalf of the Border Rivers Commission (New South Wales and Queensland), over a proposed dam site near Mingoola on the Dumaresq River. The purpose of the survey was to provide information to the Commission on the depth to bedrock in the river valley. The main part of the survey was done in 1954, but some additional short traverses were surveyed in 1955. During the 1955 survey, brief investigations were also made at two alternative sites on Pikes Creek and Mole River.

The contour map showing the depth to bedrock reveals a trough in the central portion of the area surveyed in which the maximum depth to bedrock is more than 300 ft. below datum level. Upstream from this trough the maximum depth decreases gradually to a value of about 200 ft. on the northernmost traverse.

A statistical analysis of the results obtained indicates that the error in the depth estimates ranges from 78 per cent at a depth of 50 feet to 14 per cent at a depth of 250 feet.

The surveys at Pikes Creek and Mole River indicated that the overburden at both of these sites is much thinner than that at the Mingoola site.

1. INTRODUCTION

The Dumaresq River, which forms part of the border between north-eastern New South Wales and south-eastern Queensland, is a tributary of the McIntyre River. The New South Wales Water Conservation and Irrigation Commission, on behalf of the Border Rivers Commission (New South Wales and Queensland), has been investigating an area near Mingoola for a dam site. The purpose of the dam is to provide continuity of water supply downstream for irrigation. The Commission asked the Bureau of Mineral Resources to assist in determining, by geophysical methods, the depth to bedrock in the river valley. The area investigated is in a narrow part of the valley, approximately one mile downstream from Mingoola Homestead, and is about two miles long and 1,500 to 2,000 feet wide (Plate 1).

The geophysical survey was made during September and October, 1954 by a party consisting of E.R. Smith (party leader) and M.J. O'Connor (geophysicist). Preliminary results of this survey were forwarded to the Commission in December, 1954.

Additional seismic traverses were surveyed in September 1955, by a Bureau party consisting of E.J. Polak (party leader) and J.P. Piggott (field assistant). Results of both surveys are included in this report.

At the request of the Commission some traverses were surveyed near Pike's Creek and Mole River, during the 1955 survey, to ascertain whether these locations were worthy of consideration as alternative dam sites. The results of these investigations were forwarded to the Commission in May, 1956, and are included as an Appendix to this report.

The New South Wales Commission supplied assistants and undertook the topographical survey of the traverses.

It is desired to acknowledge the assistance given to the parties by members of the staff of the Water Conservation and Irrigation Commission, and especially that given by Mr. H.A. Brice.

2. GEOLOGY.

The geology of this area has been described in a preliminary report by Mulholland and Whiting (1950).

The main rock types in the area are silicified and indurated mudstones, quartzites and greywacke of Palaeozoic age. Along the river, these formations are overlain by alluvium and scree.

The rocks that crop out along the valley and which may serve as abutments for a dam, consist of hard, dark grey mudstone, which weathers to a softer, yellow rock.

On the left bank of the river near dam sites 2 and 3 (see Plate 1), the mudstones show evidence of shearing and a cleavage has developed which strikes N 30° W and dips steeply to the north-east. The strike of the cleavage coincides approximately with the regional strike of rocks in the area.

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The overburden is here defined as the alluvial deposits, scree and weathered Palaeozoic rocks, and the bedrock as unweathered Palaeozoic rocks.

3. METHOD AND EQUIPMENT

(a) General description.

The seismic refraction technique, which was used in this survey, is particularly suitable for shallow investigations such as the determination of the thickness of overburden. The method is based on the velocity contrast of elastic waves in different rock formations.

An explosion sets up a wave train in the ground and the travel times from the shot point to each of a spread of seismometers or geophones in line with the shot point are accurately recorded. From the travel time data the seismic velocities and the depth to successive formations were determined.

In seismic refraction work for engineering problems three main formations are usually distinguished, namely:-

(i) soil

(ii) weathered rock

(iii) unweathered rock.

The soil thickness is seismically determined and the layer of soil is "replaced" by an equivalent thickness of weathered rock. The application of this "soil correction" reduces the three-layer problem to a two-layer problem.

Consider a wave striking the interface between two formations of velocities V_1 and V_2. Snell's law of Refraction states that

$$\frac{\sin i_1}{\sin i_2} = \frac{V_1}{V_2}$$

where i_1 is the angle of incidence and i_2 the angle of refraction. If $V_2 > V_1$ then $i_2 > i_1$ and the wave is refracted away from the normal to the interface. For a certain critical angle of incidence i_c, the angle of refraction becomes 90°, $\sin i_c = \frac{V_1}{V_2}$, and the refracted ray travels along the interface with velocity V_2. The wave is then continually refracted from the interface at the critical angle i_c into the formation of velocity V_1.

For a spread of detectors such as D_1, D_2, etc. (see Fig. 1 (a), placed in line, up to a certain critical distance x_c from the shot point S_1, the first arrivals of energy at the detectors are the direct waves through the formation of lower velocity V_1. For distances from S_1 greater than x_c, the refracted wave becomes the first arrival.

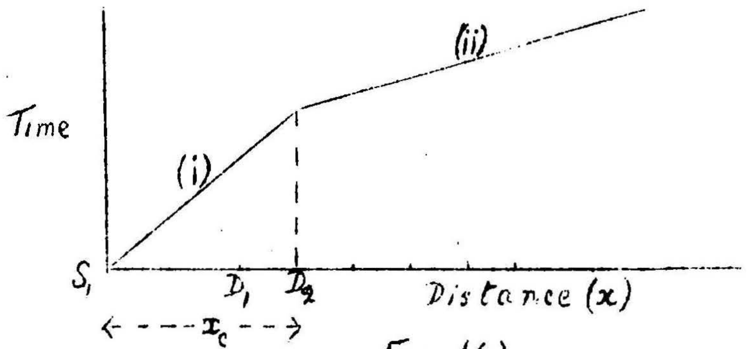

Fig. 1(a)

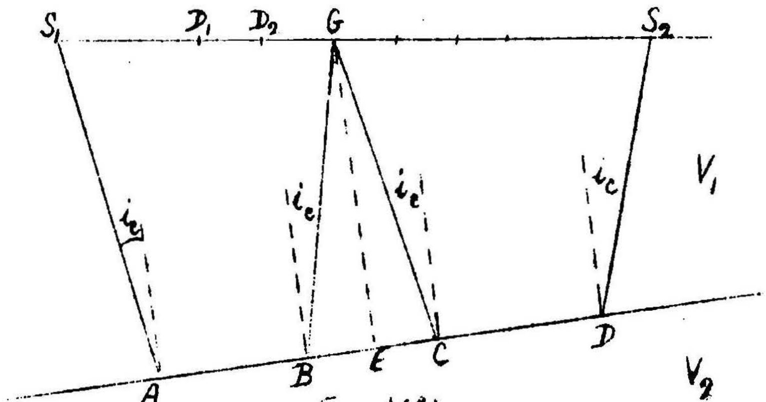

Fig. 1(b)

The shape of the time-distance curve (Fig. 1a) shows a marked change at $x = x_c$. The slope of the curve in part (i) is given by $\frac{1}{V_1}$ and the slope in part (ii) by $\frac{1}{V_2}$.

In engineering refraction work, the "method of differences" is commonly used. In fig. 1b two formations with seismic velocities V_1 and V_2 are shown ($V_2 > V_1$). The time from a shot at S_1 is recorded at G and S_2, the reciprocal shot point of S_1; the recorded seismic waves travel the paths S_1ABG and S_1ADS_2 respectively. The time from a shot at S_2 is recorded at G and S_1, the reciprocal shot point of S_2; the seismic waves travel the paths S_2DCG and S_2DAS_1 respectively. Adding the travel times for paths S_1ABG and S_2DCG and subtracting the travel time for path S_1ADS_2 gives:-

$$\left(\frac{S_1A}{V_1} + \frac{AB}{V_2} + \frac{BG}{V_1}\right) + \left(\frac{S_2D}{V_1} + \frac{DC}{V_2} + \frac{CG}{V_1}\right) - \left(\frac{S_1A}{V_1} + \frac{AD}{V_2} + \frac{S_2D}{V_1}\right)$$

$$= \frac{BG + CG}{V_1} - \frac{BC}{V_2}$$

$$= \frac{2GE}{V_1 \cos i_c} - \frac{2GE \tan i_c}{V_2} \quad \text{------------------} \quad (1)$$

Substituting $\sin i_c = \frac{V_1}{V_2}$, $\cos i_c = \frac{\sqrt{V_2^2 - V_1^2}}{V_2}$ and $\tan i_c = \frac{V_1}{\sqrt{V_2^2 - V_1^2}}$

the R.H.S. of (1) becomes

$$2GE \, \frac{\sqrt{V_2^2 - V_1^2}}{V_1 V_2} \quad \text{------------------------------} \quad (2)$$

From (2), GE, the depth of the bedrock below G can be calculated.

If $V_2 > 3V_1$ then (2) approximates to $\frac{2GE}{V_1}$ or $2t_{GE}$, t_{GE} denoting the travel time to bedrock at geophone G.

The product $V_1 t_{GE}$ yields the bedrock depth at geophone G.

In this survey, travel times are corrected for surface elevations. The travel times are reduced to a local datum level of 1150 feet and hence the depths are computed from this datum level.

The velocity (V_1) in the overburden was obtained by dividing the depth to bedrock found from drilling data by the vertical travel time measured when using the method of differences. A comparison of these values of V_1 with those obtained by weathering and normal spreads appears in the section on results.

(b) Equipment and field operation.

The equipment used in the survey was a 24-channel ABEM seismograph, manufactured by the Swedish Electrical Prospecting Company. The recording equipment was mounted in a cabin on a 4-wheel-drive truck. Two geophone cables were used, each with 13 take-offs at 60-foot intervals.

Two types of geophone spread were used, namely weathering spreads with 12 geophones spaced 10 feet apart, and normal spreads with 23 geophones spaced 50 feet apart and one geophone as a reciprocal geophone. The shot distance from the extreme end of the weathering spread was 10 feet. Weathering spreads were used to obtain the thickness and velocity of the soil, and the velocity of the overburden below the soil. These weathering spreads were placed along the profiles at intervals of about 550 feet. The shot distances from the extreme ends of the normal spreads were 50 - 100 feet and 400 - 600 feet. The data obtained from the shorter shot distances were used to find the overburden velocity. The data obtained from the longer shot distances were used to find the bedrock velocity and the travel time to bedrock at each geophone.

The charge of gelignite used for the weathering spreads was ½ stick at 1 foot depth. For normal spreads the charge was from 1 lb (3 sticks) to 20 lbs, depending on the type of soil, depth of shot-hole (2 to 5 feet), and the distance to the reciprocal geophone. The average rate of consumption of gelignite was approximately 40 lb. per 1000 feet of traverse.

Thirteen traverses were surveyed by the seismic method in 1954. Four of these traverses, namely A, B, C and D (see Plate 1), are approximately along the centre of the river valley from No. 3 dam site in the south to No.4 dam site in the north. Cross traverses K, F, E and M were surveyed at dam sites 1, 2, 3 and 4 respectively.

Intermediate cross traverses G, H, J, L and N were surveyed between dam sites No.4 and No.2.

In the 1955 survey, four additional traverses (P, Q, R and S) were surveyed and three of the earlier traverses (F, G and H) were extended. A Century 12-channel refraction equipment, Model 506 was used, the field procedure being the same as in the 1954 survey.

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4. RESULTS.

The values of the velocity V_1 obtained from the travel times to bedrock at the drill holes are compared in Table 1 with the values obtained from time-distance curves.

TABLE 1.

Drill Hole	Station Number	Depth below 1150' datum level (H) (ft)	Vertical travel time (T) (msec)	$V_1 \left(=\frac{H}{T}\right)$ (ft/sec)	Velocity from T/D curves	
					Normal spread (ft/sec)	Weathering spread (ft/sec)
8	B68	221	33.5	6600	6750	6000
			39	5650		
5	K23	35	10	3500		3300
?	B30	33	11.5	2870	6600	5950
			8.5	3880		
203	A38	241	36.5	6600		5150
			42	5750		
			40.5	5950		
302	A13	238	37	6440	6600	5400
			34	7000		

It will be noted that the velocities obtained from the time-distance curves of weathering spreads are lower than the corresponding values obtained from normal spreads. As the depth penetration of the weathering spreads is much less than that of the normal spreads this indicates that the velocity of the overburden increases with depth. This is further shown by the lower values of $\frac{H}{T}$ obtained at the drill holes where the depth to bedrock is [illegible] small, e.g. D.H.5 at station K23 and the drill hole at B30. At the latter drill hole the velocities measured from time-distance curves are approximately twice those obtained from travel times to bedrock. The values of $\frac{H}{T}$ in Table 1 are measurements of the vertical velocity $\left(\frac{H}{T}\right)$ in the overburden, whereas the time-distance curves give the velocity in a horizontal direction. For this reason the values of $\frac{H}{T}$ were used for the velocity V_1. An average value of the $\frac{H}{T}$ velocity obtained at each of the drill holes, 8, B30, 203 and 302 was used for traverses K, G F and E respectively. For traverses A and B, the differences in the values at drill holes were smoothed out between the holes. On traverse K, near D.H.5, a correction was made to allow for the low value of V_1 measured there. The value of V_1 obtained from D.H.8 was used for all traverses to the north of traverse K.

Plate 2 shows the depths to bedrock along each traverse, as computed by the "method of differences", and Plate 3 shows the contours of the top of the bedrock. Table 2 gives the maximum depths to bedrock and a measure of the width of the trough in the bedrock profile.

TABLE 2.

Traverse	Maximum depth to bedrock below surface (ft).	Distance (feet) over which the depth to bedrock is		Distance between 1200' surface contours.
		> 100'	> 50'	
E	300	1300	1800	2200
J	222	800	>1050	1700
K	227	700	>1000	1700
L	220	700	1000	1950
M	212	700	> 1000	1950

5. ACCURACY OF RESULTS

The accuracy of the depth estimation (z) depends on the velocity (v) and the vertical travel time (t).

$$z = vt$$

$$\Delta z = \frac{\partial(vt)}{t}.\Delta t + \frac{\partial(vt)}{\partial v}.\Delta v$$

$$= v\Delta t + t\Delta v$$

or $\Delta z = v\Delta t + avt = \delta 1 + \delta 2$

in which $a = \frac{\Delta v}{v}$, $\delta 1 = v\Delta t$, $\delta 2 = avt$

and

Δz = possible error in depth

Δt = " " " vertical travel time

Δv = " " " overburden velocity

$\delta 1$ = error in z due to erroneous travel time

$\delta 2$ = " " z " " " overburden velocity.

δ_1 is believed to be an error caused by variations in the soil thickness. Weathering spreads were shot at intervals of approximately 550 feet to measure the velocity in and thickness of the soil. The soil thickness was then corrected for, but variations of the soil thickness over the 550-feet intervals between weathering spreads could cause errors in this correction.

Table 3 shows how the percentage error in depth decreases with increase in depth. The values of δ_1 in Table 3 were obtained by considering a maximum value of 3 milliseconds for Δt and an average velocity of 6,000 ft/sec.

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The possible error in velocity, Δv, increases with the distance from a control point (drill hole), and varies with the difference in velocity measured at successive drill holes. As the differences in velocity measured at the drill holes are smaller in the deeper sections of the area, Δv decreases as the depth increases. However, the travel time, t, increases as the depth increases.

The estimated values for Δv, which were used to calculate the values of δ_2 in Table 3, ranged from 400 feet/sec. at a depth of 250 feet to 2,500 feet/sec. at a depth of 50 feet.

TABLE 3.

z (ft)	δ_1 (ft)	δ_2 (ft)	$\delta_1 + \delta_2$ (ft)	$100\frac{(\delta_1 + \delta_2)}{z}$ (%)
50	18	21	39	78
100	18	28	46	46
150	18	22	40	27
200	18	16	34	17
250	18	16	34	14

From Table 3 it will be seen that the depths to bedrock indicated on Plate 2 may be over-estimated by more than 50 per cent in the range 0 - 100 feet.

6. CONCLUSIONS.

Table 2 and the sections on Plate 2 show that the depth to bedrock is less along traverses J, K, L, and M than it is along the traverse to the south of J. However, even on traverses J, K, L and M the maximum depth is more than 200 feet. The abutments on traverse K (No.1 dam site) are not as far apart as on traverses L and M.

The depths to bedrock along traverse K are more accurate than those along traverses L and M because there are two drill holes on traverse K which were used to calculate the velocity of the overburden. The depths to bedrock in the shallower sections along L and M may therefore be less than indicated on Plate 2.

7. REFERENCE.

Mulholland, C. St. J and Whiting, J.W., 1950 - Preliminary report, Mingoola Dam Site, Dumaresq River, N.S.W. Water Conservation and Irrigation Commission (unpublished).

APPENDIX

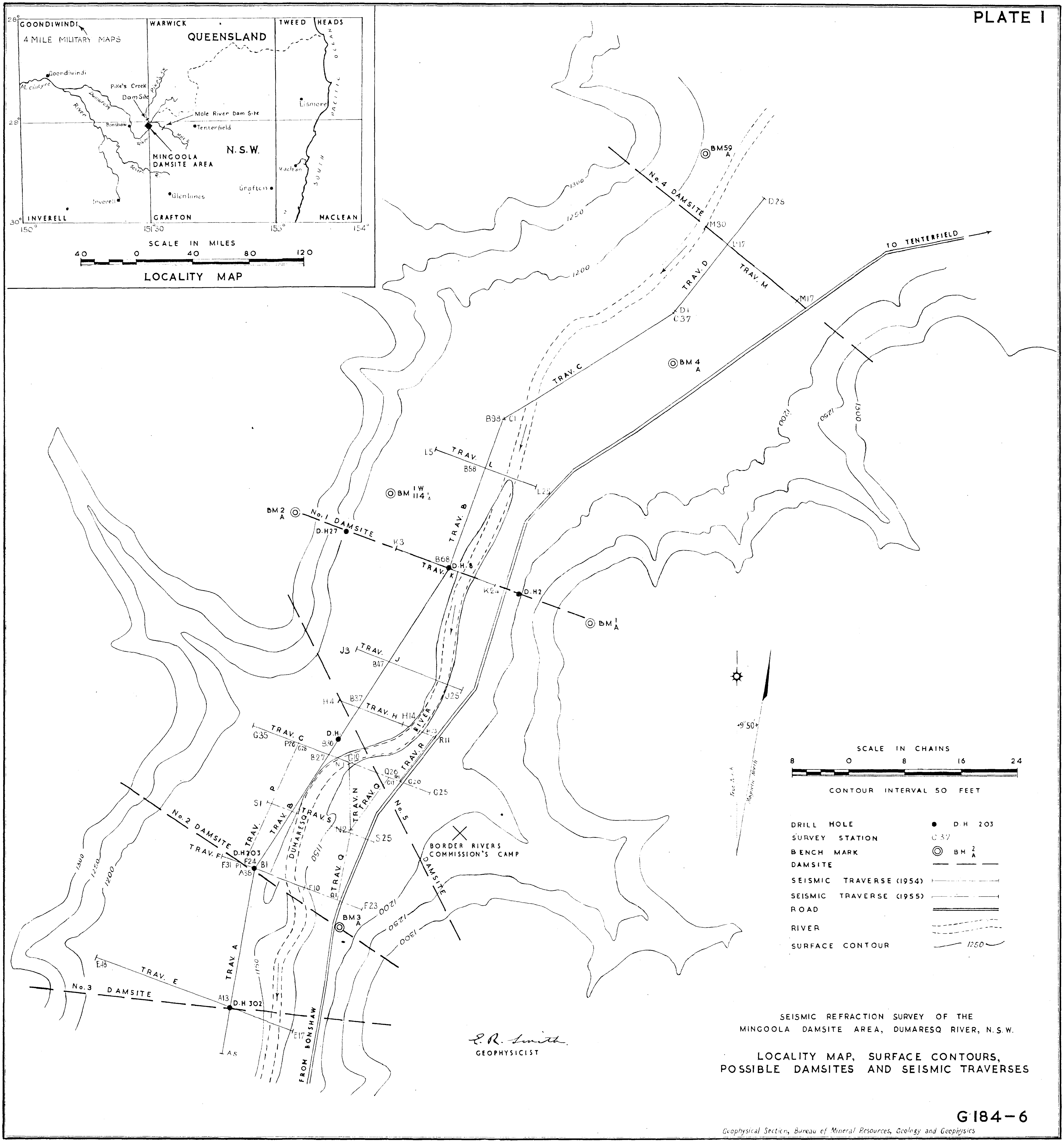
SEISMIC INVESTIGATIONS AT PIKE'S CREEK AND MOLE RIVER

In response to an application from the New South Wales Water Conservation and Irrigation Commission, two short additional seismic investigations were made in September 1955, at Pike's Creek and Mole River, the locations of which are shown on Plate 1. These investigations were made to ascertain whether the sites are worthy of consideration as alternatives to those at Mingoola. The Century 12-channel reflection equipment, Model 506, was used, the field procedure being the same as for the main survey.

(a) Pike's Creek. The survey was carried out about four miles from the junction of Pike's Creek and Dumaresq River. The location of the three traverses surveyed is shown on Plate 4, together with the profiles along the traverses showing depth to bedrock. Results indicate that the overburden ranges in thickness from 4 to 16 feet which is much less than at the Mingoola site. Bedrock velocity is about 15,000 feet per second.

(b) Mole River. The survey was made about ten miles from the junction of the Mole and Dumaresq Rivers. The location of the two traverses surveyed and the profiles showing depth to bedrock are illustrated on Plate 5. The overburden ranges in thickness from 4 to 18 feet which is much less than at the Mingoola site. Bedrock velocity is about 19,000 feet per second.

PLATE I



SEISMIC REFRACTION SURVEY OF THE MINGOOLA DAMSITE AREA, DUMARESQ RIVER, N.S.W.

LOCALITY MAP, SURFACE CONTOURS, POSSIBLE DAMSITES AND SEISMIC TRAVERSES

G184-6

Geophysical Section, Bureau of Mineral Resources, Geology and Geophysics

SEISMIC REFRACTION SURVEY OF THE MINGOOLA DAMSITE AREA, DUMARESQ RIVER, N.S.W.

SEISMIC PROFILES SHOWING DEPTH TO BEDROCK

Traverse "P"

Station No.	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13
Depth to bedrock in feet	240	257	245	256	248	262	262	260	259	260	263	250	265

Station No.	P14	P15	P16	P17	P18	P19	P20	P21	P22	P23	P24	P25	P26
Depth to bedrock in feet	259	250	249	220	223	207	185	175	136	136	121	108	80

Traverse "E"

Depth to bedrock in feet	Station No.
0	E48
25	E47
32	E46
60	E45
60	E44
88	E43
100	E42
113	E41
126	E40
144	E39
153	E38
174	E37
178	E36
198	E35
214	E34
218	E33
220	E32
232	E31
256	E30
266	E29
276	E28
291	E27
300	E26
291	E1
281	E2
272	E3
276	E4
254	A13
214	E6
210	E7
190	E8
143	E9
103	E10
71	E11
51	E12
—	E13
56	E14
39	E15
57	E16
51	E17

Traverse "F"

Depth to bedrock in feet	Station No.
251	F31
247	F30
244	F29
234	F28
230	F27
240	F26
234	F25
250	F24
255	F1
236	F2
195	F3
—	F4
140	F5
130	F6
124	F7
124	F8
111	F9
114	F10
	F11
83	F12
65	F13
76	F14
79	F15
84	F16
88	F17
63	F18
45	F19
25	F20
22	F21
20	F22
25	F23

Traverse "S"

Depth to bedrock in feet	Station No.
275	S1
260	S2
256	S3
258	S4
250	S5
262	S6
270	S7
267	S8
262	S9
262	S10
	S11
278	S12
295	S13
289	S14
296	S15
281	S16
259	S17
261	S18
257	S19
266	S20
276	S21
267	S22
260	S23
250	S24
238	S25

Traverse "G"

Depth to bedrock in feet	Station No.
67	G35
82	G34
76	G33
73	G32
73	G31
70	G30
64	G29
70	G28
55	G27
65	G26
60	G1
58	G2
56	G3
72	G4
66	G5
80	G6
70	G7
—	G8
—	G9
157	G10
240	G11
267	G12
276	G13
295	G14
310	G15
292	G16
287	G17
280	G18
278	G19
261	G20
243	G21
249	G22
247	G23
261	G24
267	G25

Traverse "N"

Station Number	N2	N3	N4	N5	N6	N7	N8	N9	N10	N11	G10
Depth to bedrock in feet	250	238	222	230	229	220	200	185	185	162	160

Traverse "H"

Depth to bedrock in feet	Station No.
	H1
	H2
	H3
31	H4
52	H5
70	H6
96	H7
96	H8
93	H9
105	H10
132	H11
150	H12
159	H13
175	H14
226	H15
241	H16
258	H17
275	H18
282	H19
	H20
278	H21
272	H22
280	H23

Traverse "J"

Depth to bedrock in feet	Station No.
	J1
	J2
28	J3
53	J4
60	J5
63	J6
65	J7
75	J8
93	J9
106	J10
125	J11
136	J12
166	J13
193	J14
209	J15
214	J16
222	J17
216	J18
211	J19
196	J20
—	J21
175	J22
165	J23
137	J24
125	J25

Traverse "K"

Depth to bedrock in feet	Station No.
	K1
	K2
70	K3
80	K4
100	K5
112	K6
131	K7
147	K8
154	K9
156	K10
164	K11
179	K12
186	K13
206	K14
227	B68
195	K16
168	K17
—	K18
100	K19
88	K20
84	K21
54	K22
45	K23
20	K24

Traverse "L"

Depth to bedrock in feet	Station No.
	L1
	L2
	L3
	L4
70	L5
81	L6
90	L7
103	L8
129	L9
135	L10
171	L11
195	L12
220	L13
214	L14
206	B88
190	L16
167	L17
141	L18
137	L19
—	L20
—	L21
106	L22
97	L23
80	L24
61	L25

Traverse "M"

Depth to bedrock in feet	Station No.
112	M30
130	M29
150	M28
158	M27
163	D17
185	M1
208	M2
212	M3
195	M4
175	M5
168	M6
150	M7
156	M8
117	M9
110	M10
106	M11
97	M12
89	M13
75	M14
72	M15
54	M16
37	M17

Traverses "A", "B", "C", "D"

Station No.	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	A20	A21	A22	A23	A24
Depth to bedrock in feet	217	212	227	220	227	216	225	235	254	215	222	225	231	226	216	216	215	203	210	202

Station No.	A25	A26	A27	A28	A29	A30	A31	A32	A33	A34	A35	A36	A37	A38 B1	B2	B3	B4	B5	B6	B7
Depth to bedrock in feet	198	188	178	189	174	168	183	183	190	193	209	220	—	250	—	—	260	260	244	230

Station No.	B8	B9	B10	B11	B12	B13	B14	B15	B16	B17	B18	B19	B20	B21	B22	B23	B24	B25	B26	B27
Depth to bedrock in feet	230	248	252	239	251	260	267	255	258	251	240	228	212	177	144	132	113	86	78	73

Station No.	B28	B29	B30	B31	B32	B33	B34	B35	B36	B37	B38	B39	B40	B41	B42	B43	B44	B45	B46	B47
Depth to bedrock in feet	69	50	45	52	60	71	82	82	80	94	86	90	104	104	104	101	107	116	119	104

Station No.	B48	B49	B50	B51	B52	B53	B54	B55	B56	B57	B58	B59	B60	B61	B62	B63	B64	B65	B66	B67
Depth to bedrock in feet	114	116	133	150	147	166	172	179	185	185	193	209	215	215	219	220	224	224	220	217

Station No.	B68	B69	B70	B71	B72	B73	B74	B75	B76	B77	B78	B79	B80	B81	B82	B83	B84	B85	B86	B87
Depth to bedrock in feet	227	212	215	218	214	216	206	211	211	206	208	209	209	204	202	202	199	202	214	211

Station No.	B88	B89	B90	B91	B92	B93	B94	B95	B96	B97	B98	C1	C2	C3	C4	C5	C6	C7	C8	C9
Depth to bedrock in feet	206	205	210	212	210	206	203	205	210	—	—	—	—	—	195	175	—	182	184	184

Station No.	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21	C22	C23	C24	C25	C26	C27	C28	C29
Depth to bedrock in feet	199	210	225	222	216	227	232	232	—	214	226	206	206	216	201	209	190	202	202	—

Station No.	C30	C31	C32	C33	C34	C35	C36	C37 D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13
Depth to bedrock in feet	210	—	208	200	197	201	215	210	195	209	215	200	207	209	209	209	209	209	193	190

Station No.	D14	D15	D16	D17	D18	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28
Depth to bedrock in feet	190	190	178	—	178	187	168	170	174	185	185	176	180	178	188

Traverses "Q" and "R"

Station No.	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19
Depth to bedrock in feet	84	85	87	90	94	133	161	178	214	240	269	294	284	275	276	253	257	273	270

Station No.	Q20	Q21	Q22	Q23	Q24	Q25	Q26	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11
Depth to bedrock in feet	287	296	316	309	290	282	287	264	278	280	287	292	310	295	276	267	240	250

LEGEND

(6500)	SEISMIC VELOCITIES IN FEET PER SECOND
*	VELOCITIES MEASURED BY WEATHERING SPREADS
— · — · —	SEISMIC SURVEY CARRIED OUT IN 1954
————	SEISMIC SURVEY CARRIED OUT IN 1955

E.R. Smith
GEOPHYSICIST

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SEISMIC REFRACTION SURVEY OF THE MINGOOLA DAMSITE AREA,
DUMARESQ RIVER, N.S.W.

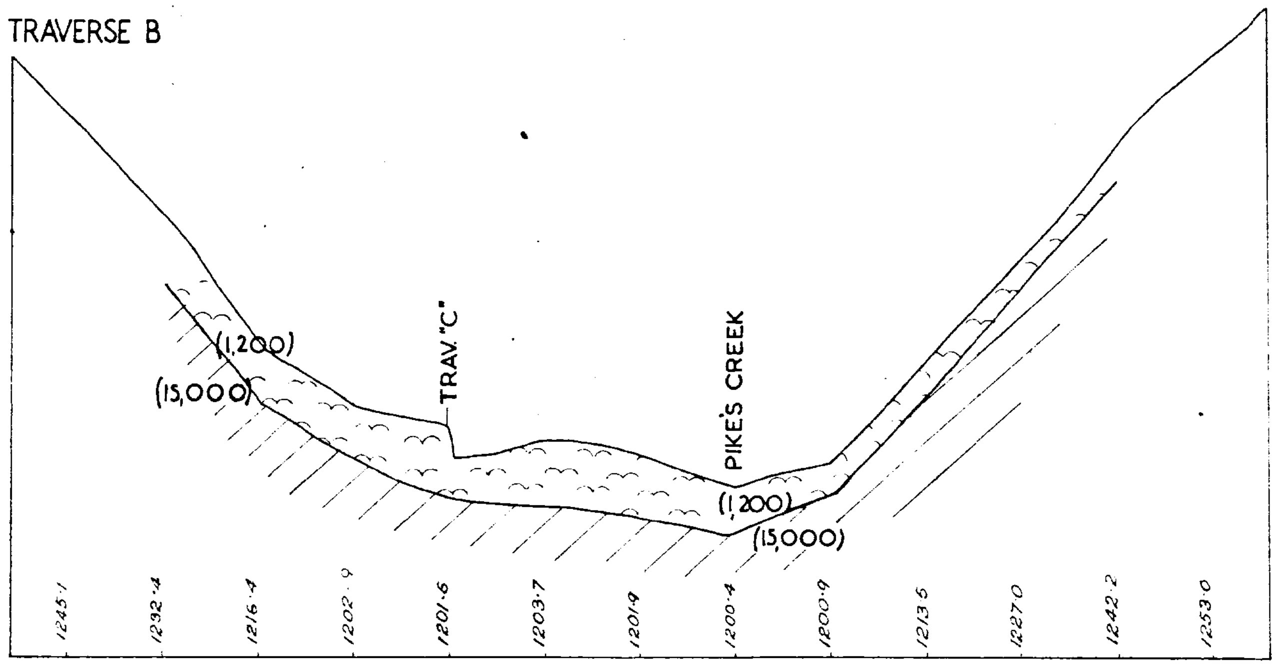
CONTOURS OF SURFACE OF BEDROCK

(FIGURES ARE DEPTHS BELOW DATUM LEVEL (1150))

Geophysical Section, Bureau of Mineral Resources, Geology and Geophysics

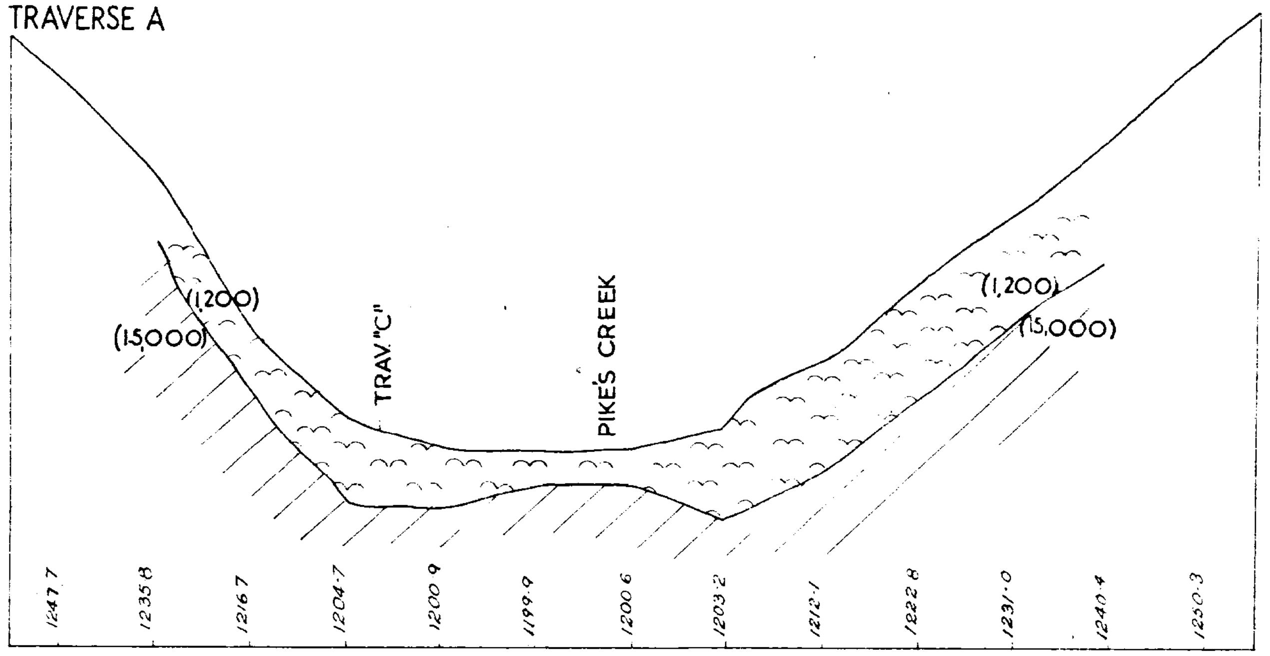
G 184-9

TRAVERSE B



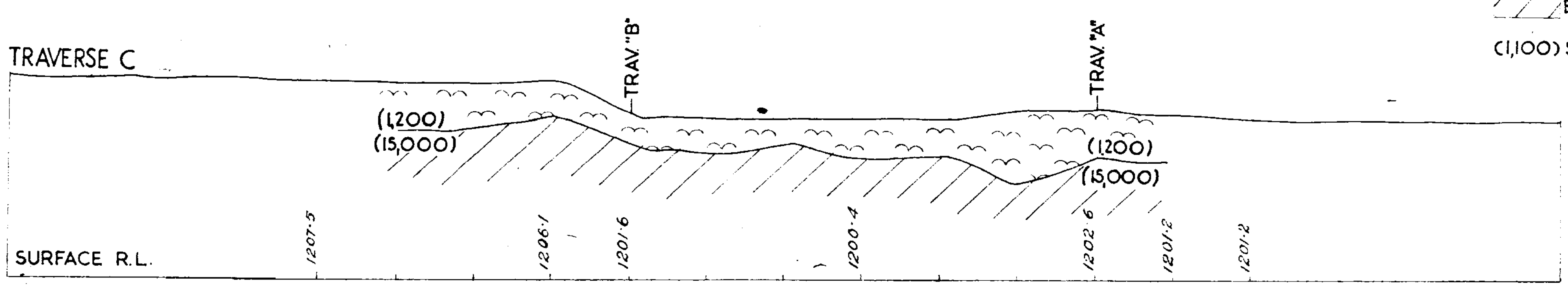
STATION	1	2	3	4	5	6	7	8	9	10	11
DEPTH TO BEDROCK IN FEET	9	7	7	5	9	9	6	5	4	4	5

TRAVERSE A

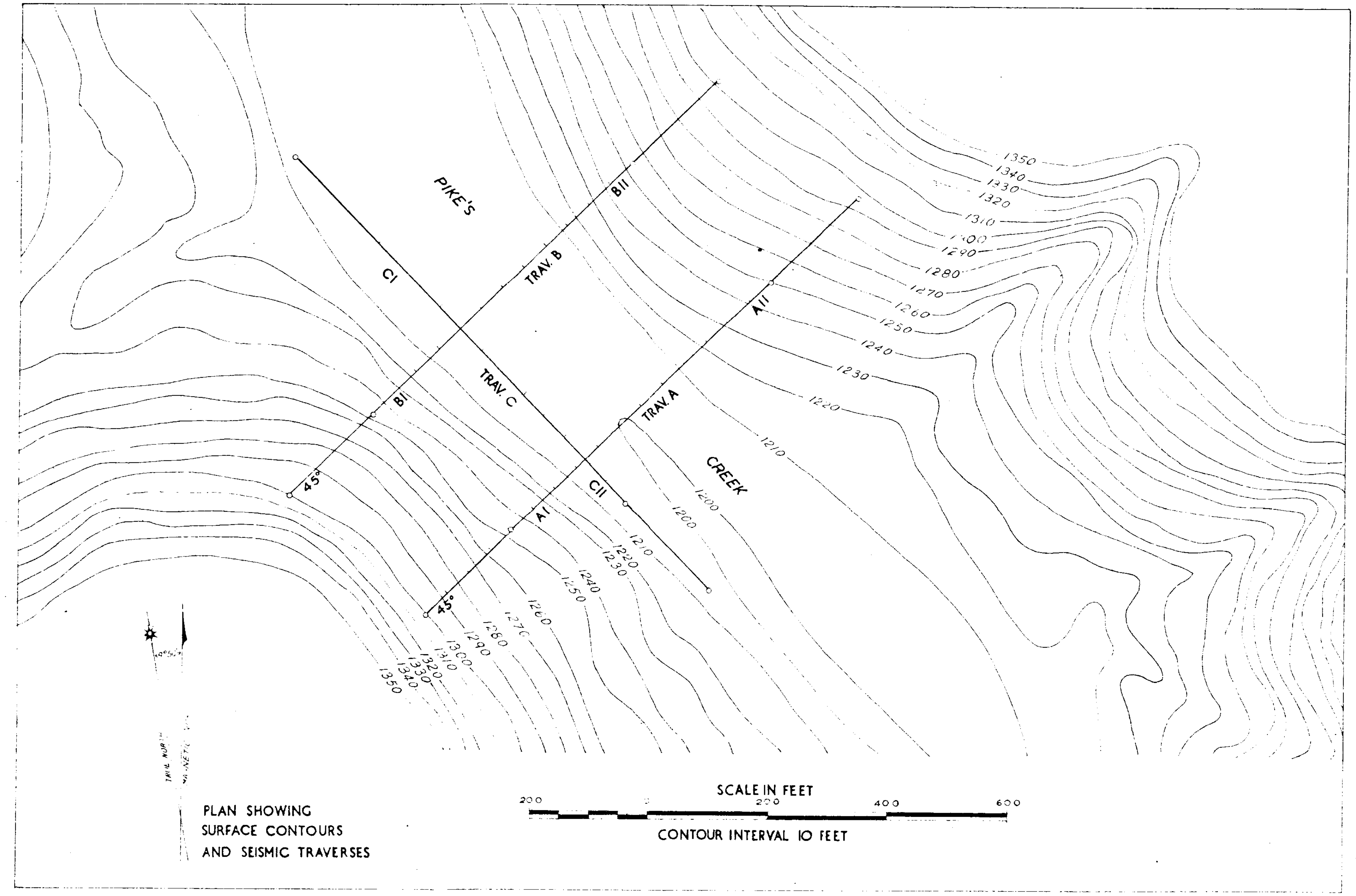


STATION	1	2	3	4	5	6	7	8	9	10	11
DEPTH TO BEDROCK IN FEET	9	10	11	8	4	5	13	15	15	14	16

TRAVERSE C



STATION	1	2	3	4	5	6	7	8	9	10	11
DEPTH TO BEDROCK IN FEET	8	7	6	5	6	5	6	6	11	8	7



PLAN SHOWING SURFACE CONTOURS AND SEISMIC TRAVERSES

ALLUVIUM AND ELUVIUM

BEDROCK

(1,100) SEISMIC VELOCITY IN FT/SEC

SCALES IN FEET

HORIZONTAL 100 — 0 — 100 — 200 — 300

VERTICAL 25 — 0 — 25 — 50 — 75

E. Polak
GEOPHYSICIST

SEISMIC SURVEY AT
PIKE'S CREEK, QUEENSLAND
MINGOOLA PROJECT

SEISMIC PROFILES SHOWING DEPTH TO BEDROCK

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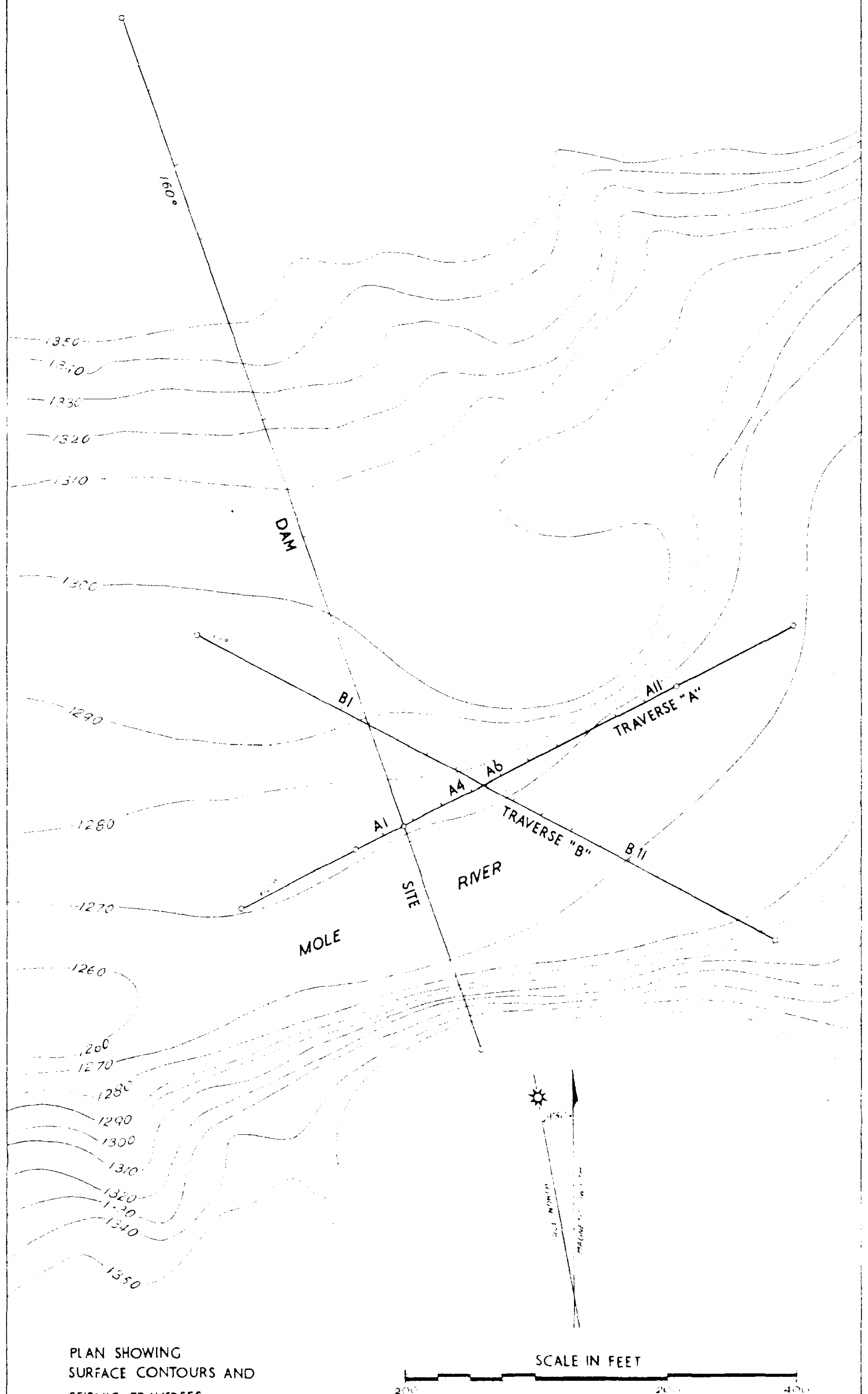
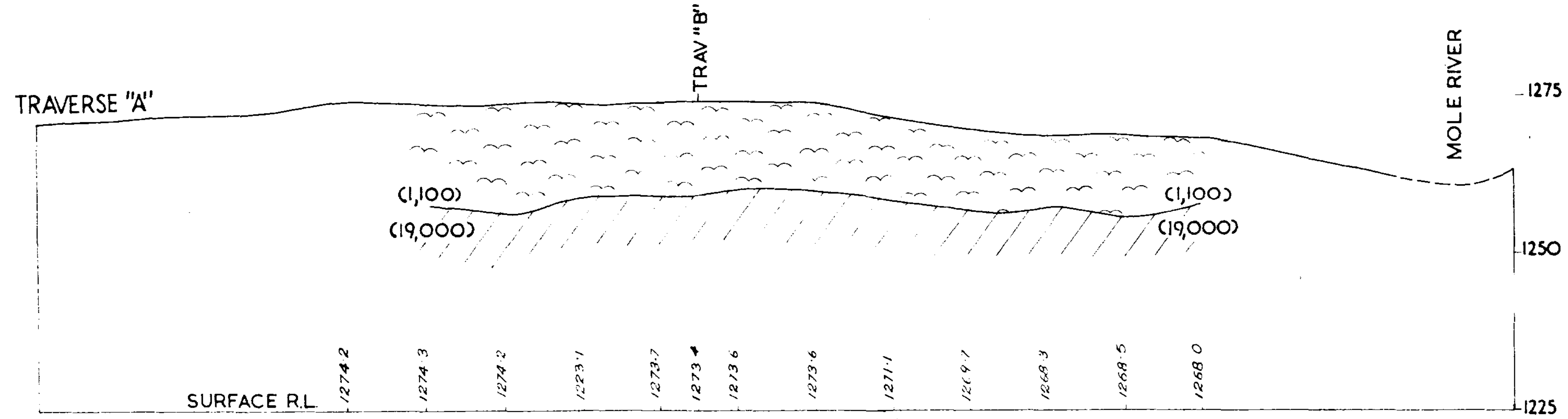
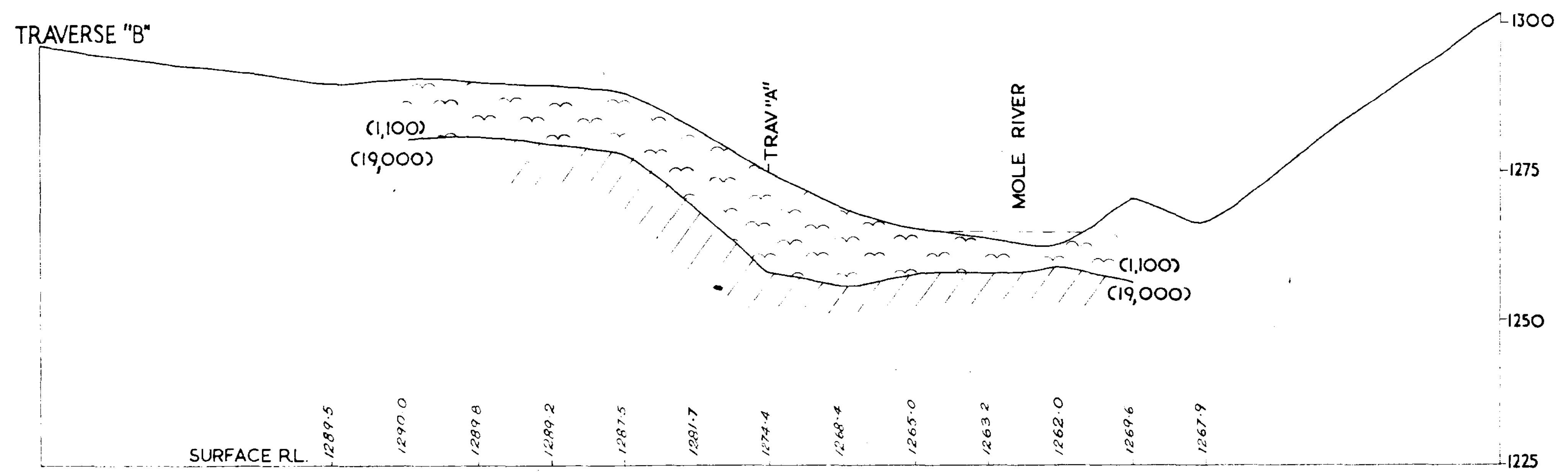
GEOPHYSICAL SECTION BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS





STATION	1	2	3	4	5	6	7	8	9	10	11
DEPTH TO BEDROCK IN FEET	16	18	15	16	15	14	14	14	14	12	14



STATION	1	2	3	4	5	6	7	8	9	10	11
DEPTH TO BEDROCK IN FEET	10	9	11	10	14	17	14	8	7	4	14

ALLUVIUM AND ELUVIUM

BEDROCK

(1,100) SEISMIC VELOCITY IN FT/SEC

SCALES IN FEET

HORIZONTAL 100 0 100 200 300

VERTICAL 25 0 25 50 100

E. Polak

GEOPHYSICIST

SEISMIC SURVEY AT

MOLE RIVER, NEW SOUTH WALES

MINGOOLA PROJECT

SEISMIC PROFILES SHOWING DEPTH TO BEDROCK

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