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RECORD No. 1962/68

UPPER PIEMAN HYDRO-ELECTRIC SCHEME GEOPHYSICAL SURVEY, TASMANIA 1960

by

E. J. POLAK

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ILLUSTRATIONS

SUMMARY

This report describes seismic refraction, magnetic, and resistivity surveys on the Upper Pieman Power development scheme of the Hydro-Electric Commission of Tasmania. The purpose of the surveys was to determine the depth to the bedrock, and the nature of the bedrock and overburden at five localities, viz: Spillway of the Hanging Rock dam site, Buttress Hill dam site, Tullibardine Saddle dam site, Murchison No. 4 dam site, and Boco Saddle dam site.

At Hanging Rock dam site spillway, the velocity of the bedrock is from 14,000 to 17,000 ft/sec, and the greatest depth to bedrock is 112 ft. The overburden consists of soil, gravel, and weathered rock.

At Buttress Hill dam site, the overburden consists of soil, gravel, and weathered rock, and attains a maximum thickness of 198 ft. The velocity in the bedrock ranges from 11,000 to 17,000 ft/sec.

At Tullibardine Saddle dam site the overburden consists of soil, peat, and gravel, and has a maximum thickness of 133 ft. The velocity in the bedrock is 15,000 to 16,000 ft/sec.

At Murchison No. 4 dam site the overburden consists of talus material, with a maximum thickness of 89 ft. The velocity in bedrock is from 9000 to 16,000 ft/sec.

At Boco Saddle dam site the surveys showed a great thickness of low-velocity rock. The velocity in the bedrock ranges from 9000 to 15,000 ft/sec.

1. INTRODUCTION

The Hydro-Electric Commission of Tasmania intends to construct power stations to utilize the power resources of the Upper Pieman system, which is formed by the Mackintosh and Murchison Rivers and their tributaries.

The power station highest up-stream will be near Tullah (Plate 1). A dam on the Mackintosh River will be erected and will flood the Mackintosh and Sophia River valleys. The impounded water will flow through a tunnel into the Murchison River, where the power station will be constructed. The Tullibardine Saddle dam will be constructed to prevent water from the Mackintosh River overflowing into the Tullibardine Creek.

In the second stage a dam will be constructed on the Pieman River down-stream from Farrell Junction.

Three possible sites were chosen for the dam on the Mackintosh River (Plate 1). Two sites are near the Hanging Rock and the lowest site is near Buttress Hill. Several drill holes have been put down on these sites and two geophysical surveys were carried out on the Hanging Rock sites (Polak, 1957b; Dyson and Bamber, 1959a).

Of four possible sites chosen for further investigation on the Murchison River, Murchison No. 1 dam site was surveyed geophysically in 1957 (Polak, 1957a). A geophysical survey was also made of the Rosebery No. 1 dam site on the Pieman River (Dyson and Bamber, 1959b).

In response to an application from the HEC the Bureau of Mineral Resources, Geology and Geophysics carried out further geophysical surveys in March and April 1960 on the following sites:

Hanging Rock dam site, spillway section

Buttress Hill dam site

Tullibardine Saddle dam site

Murchison No. 4 dam site

Boco Saddle dam site

The object of the surveys was to determine the depth to the bedrock, and the nature of bedrock and overburden.

As used in this report the term 'bedrock' refers to unweathered or to jointed rock in a refractor showing the highest seismic velocity. The term 'overburden' refers to river gravel, clay, scree and talus material, and completely or partly weathered rock, all with seismic velocities of less than 9000 ft/sec. A distinction is made between the terms 'talus' and 'scree'; talus includes some clay but scree is free from clay.

Seismic refraction, magnetic and resistivity methods were used. The geophysical party consisted of E.J. Polak, party leader, and D.J. Harwood and M.J.W. Duggin, geophysicists. The HEC provided field assistants and carried out topographical surveys along the traverse lines.

Table 1 shows the length of traverse surveyed at each locality by the three geophysical methods.

TABLE 1

Locality	Seismic Method (ft)	Magnetic Method (ft)	Resistivity Method (ft)
Hanging Rock	4050	-	-
Buttress Hill	9100	2250	4500
Tullibardine	3550	3500	900
Murchison No. 4	7200	-	-
Boco	4250	-	1550
Total	28,150	5750	6950

2. GEOLOGY

The geology of the area is described by Ward (1908) and Bradley (1954 and 1956). The sites were geologically mapped in detail by Mather (1957).

Plate 1 shows the geological map of the area. The whole area consists of the Ordovician and Cambrian rocks, covered in places with scree, glacial, and alluvial material.

The Dundas Group rocks are of Cambrian age (Opik, 1951) and consist of slate, chert, schist, and greywacke. The bedding planes of the formations are nearly vertical.

The Owen Conglomerate is part of the West Coast Range Conglomerate series and is of Cambro-Ordovician age (Opik, 1951). The conglomerate is wholly quartzose in composition and contains pebbles (2 to 4 inches in diameter) of reef quartz and quartz schist. The matrix has been altered to quartzite material. The rock is strongly resistant to weathering.

The geology of each dam site will be discussed separately.

3. METHODS AND EQUIPMENT

All the methods used have been described in detail by Polak and Moss (1959).

Seismic method

The 'method of differences' (Heiland, 1946, p. 548) was used for traverses along the slope, and broadside spreads were used on steep banks.

The equipment used in the survey was an SIE 12-channel refraction seismograph with TIC geophones having a natural frequency of about 20 c/s.

Magnetic method

A Watts vertical force variometer was used for the survey.

Resistivity method

In the Wenner method of resistivity surveying (Heiland, 1946; p. 707), which was used in the present investigation, four electrodes equally spaced in a straight line are moved as a whole along a traverse, and readings are taken at consecutive stations. In the interpretation, absolute values of resistivity are not as important as sudden changes from high to low resistivity - such changes generally indicate a change in rock type.

A Tellohmeter was used for the investigation.

4. HANGING ROCK DAM SITE

Introduction

A detailed geophysical survey on the Hanging Rock dam site has previously been carried out (Polak, 1957b; Dyson and Bamber 1959a). This report covers the results of a later investigation on the spillway of the same dam site.

Geology

Plate 2 shows the geology of the area surveyed. The whole of the area is covered with gravel , with occasional floaters of the Owen Conglomerate. Some outcrops of the 'bedded series' of Cambrian rocks have been identified near the crest of the divide between the Mackintosh River and Tullibardine Creek.

Seismic results

Plate 2 shows the arrangement of the geophysical traverses. Table 2 gives seismic wave velocities on the spillway section.

TABLE 2

Seismic velocity (ft/sec)	Rock type
1000 to 1800	Soil
4000 to 5000	Gravel
4000 to 9000	Weathered Rock
14,000 to 17,000	Unweathered Rock

A velocity of 9000 ft/sec was recorded only on weathering spreads; apparently the bed is too thin to be recorded on normal spreads with 50-ft geophone spacing.

The depth to the bedrock, the highest seismic velocity refractor, was calculated by the use of apparent velocities obtained from weathering spreads. The depths thus calculated are plotted on Plate 3.

The cross-sections on Plate 3 indicate a thin cover of soil and gravel along the crest of the hill, with a great increase in thickness towards the Mackintosh River. This corroborates data from the previous surveys.

Elastic properties of rocks

Table 3 shows the values of longitudinal and transverse wave velocities measured together on the Hanging Rock spillway site. The elastic properties were calculated (Polak and Moss, 1959) assuming a density of 2.7 g/cm^3 for bedrock.

TABLE 3

Location	Apparent Velocity		True Velocity	Poisson's	Modulus (10^6 lb/sq.in)		
	Long.	Trans.	(Longitudinal)	ratio	Young's	Bulk	Rigidity
D1	11,900	6800	16,500	0.26	8.1	5.6	3.25
E8	14,100	8200	17,000	0.26	8.5	5.9	3.4

Conclusions

The geophysical survey provided information on the depth to the bedrock at the Hanging Rock spillway site.

The overburden consists of soil, gravel, and weathered rock. The estimated maximum thickness of overburden is 112 ft near station EE23. The bedrock consists of high-velocity rock (14,000 to 17,000 ft/sec) with Young's modulus of about 8.5 x 10^6 lb/in^2.

5. BUTTRESS HILL DAM SITE

Introduction

The proposed dam at Buttress Hill is an alternative to the Hanging Rock dam and is located approximately 1 mile down-stream (Plate 1).

Geology

Plate 4 shows the geology of the dam site. The whole of the area is covered with soil and gravel except for the area close to the river, where massive pyroclastics crop out. The maximum thickness of gravel proved in drill hole DDH 6526 is 79 ft. The bedrock consists of bedded series rocks (Cambrian) in the eastern part of the site and of massive pyroclastics in the western part. The Owen Conglomerate crops out to the east of the site. Evidence for the existence of a fault has been found.

Seismic results

Plate 4 shows the arrangement of the geophysical traverses. Table 4 gives seismic wave velocities on the Buttress Hill dam site.

TABLE 4

Seismic velocity (ft/sec)	Rock type
1000 to 2000	Soil
2500 to 3100	Scree material
4000 to 6000	Gravel
5000 to 9000	Weathered rock
11,000 to 17,000	Unweathered rock

Notes to Table 4

(a) Seismic velocities in gravel and weathered bedrock overlap and it is therefore impossible to find the thickness of gravel. As has already been mentioned, the weathered bedrock is classified as overburden.

(b) Measured seismic velocities in the bedrock are higher along the strike of rocks (traverses along the river) than on traverses across the bedding planes.

(c) The main refractor with the velocity of 11,000 to 17,000 ft/sec is a rock with unweathered joints. Therefore this horizon is deeper than that recorded on the HEC drill hole logs as 'mainly sound rock'.

There are apparent discrepancies in the depths indicated at the intersection of two traverses, where a steep interface underlies the common point. These discrepancies result from the seismic waves arriving from different points of the refracting surface. Consider the intersection between Traverses F and A on Plate 6. The wave travelling along Traverse A and arriving at the intersection will be refracted from the buried ridge, located under station F11. Thus the depth indicated on Traverse A will be shallower than that indicated on Traverse F, normal to Traverse A.

Table 5 gives a comparison between drilling and seismic data.

TABLE 5

Station No.	Drill Hole No.	Depth from drilling (ft)	Rock type	Depth from seismic data (ft)	Seismic velocity (ft/sec)
K12	6522	0-49 49-	gravel mainly sound rock Total depth 97 ft.	64-	14,300
K7-8	6523	0-71 71-	gravel mainly sound rock Total depth 77 ft.	137-	15,000
J7	6524	0-77 77-	gravel weathered massive pyroclastics Total depth 91 ft.	109-	16,500
E10	6525	0-25 25-38 38-	gravel weathered pyroclastics mainly sound rock Total depth 54 ft.	70-	16,500
D11-12	6526	0-79 79-	gravel Farrell slate Total depth 85 ft.	101-	14,000

Seismic results are shown on Plates 5 to 7.

The main features indicated by the seismic survey are:-

(a) On the left bank of the river (Plate 5) the thickness of the overburden increases away from the river, reaching a maximum of 119 ft near station A11. On the right bank of the river, after an initial increase in thickness (possibly an old river valley), the overburden thins out towards the outcrops on the ridge, where weathered rock lies directly under a thin layer of soil. Similar features were found on the Hanging Rock dam site (Polak, 1957b; Dyson and Bamber, 1959a)

(b) The old river terrace is indicated clearly on the left bank of the river.

Elastic Properties of Rocks

Table 6 shows the values of longitudinal and transverse wave velocities measured together on the Buttress Hill dam site. The elastic properties were calculated assuming a density of 2.7 g/cm^3 for bedrock.

TABLE 6

Station No.	Apparent velocity Long.	Apparent velocity Trans.	True velocity	Poisson's ratio	Modulus (10^6 lb/sq.in) Young's	Bulk	Rigidity
A26	13,800	7600	15,000	0.28	6.4	4.35	2.6
J7	9100	5000	16,500	0.27	7.8	5.7	3.1

Resistivity Results

Resistivity constant-spacing profiles (see Plate 5) clearly indicate a low-resistivity area over the 'bedded series'. The increase in resistivity towards the south-east may indicate the boundary between 'bedded series' and Owen Conglomerate (a similar feature was proved by drilling at the Hanging Rock dam site).

Magnetic Results

Magnetic intensity profiles (Plate 5) indicate a magnetic 'low' near station A6. This may be due to the demagnetization of rocks in the shattered zone of the fault shown on Plate 4.

Conclusions

The geophysical survey provided information on the depth to the bedrock at the Buttress Hill dam site. The overburden consists of soil, gravel, and weathered rock and its estimated maximum thickness is 198 ft near station A36. The velocity in the bedrock ranges from 11,000 to 17,000 ft/sec. The bedrock is deeper than that marked on the HEC logs as 'mainly sound rock'.

6. TULLIBARDINE SADDLE DAM SITE

Introduction

The construction of a dam at either Hanging Rock or Buttress Hill will require the raising of the Tullibardine Saddle, approximately one mile north of the Hanging Rock dam site (Plate 1).

Geology

Plate 8 shows the geology of the area. The low-lying sections are covered with black peat; on higher ground some fragments of rocks are embedded in the soil. Massive pyroclastics crop out on Traverse D and north and south of the area investigated. There are no drill holes in the area.

Seismic Results

Plate 8 shows the arrangements of the geophysical traverses. Table 7 gives seismic wave velocities measured on the Tullibardine Saddle dam site.

TABLE 7

Seismic velocity (ft/sec)	Rock type
1000	Soil
5000 to 6000	Peat and wet gravel
15,000 to 16,000	Bedrock

The depth to bedrock was calculated by the use of apparent velocities obtained from weathering spreads. The results are shown on Plates 9 and 10. Cross-sections A, B, and C were calculated using the 'method of differences'; therefore the depths determined on these traverses are more accurate than on Traverse D, where a broadside-shooting technique was used.

Constant-spacing resistivity profiles on Traverse B (Plate 9) indicate a broad low-resistivity valley with increases in resistivity values near outcrops.

Magnetic profiles indicate small increases in magnetic intensity towards outcrops and also, two uplifts in the bedrock (Traverse D, Plate 10) are clearly indicated by the magnetic profile.

Conclusions

The geophysical survey provided information on the depth to the bedrock at the Tullibardine Saddle dam site. The overburden consists of soil, peat, and gravel and has an estimated maximum thickness of 133 ft near station D12. Velocities in the bedrock are high (15,000 to 16,000 ft/sec).

7. MURCHISON NO. 4 DAM SITE

Introduction

The proposed Murchison No. 4 dam site (Plate 1) is an alternative to the Murchison No. 1 dam site which is located less than one mile down-stream and has been previously investigated by Polak (1957a).

Geology

Plate 11 shows the geology of the dam site. The bedrock in the area consists of 'igneous types from the Murchison River' (Mather, 1959). These rocks have been derived from Dundas Group rocks by metamorphism. In places the bedrock is covered with talus material. Six drill holes have been put down to prove the thickness of talus material.

Seismic Results

Plate 11 shows the arrangement of the seismic traverses. Table 8 gives seismic wave velocities on the Murchison No. 4 dam site.

TABLE 8

Seismic velocity (ft/sec)	Rock type
1000	Soil
2000 to 3000	Talus material
5000 to 9000	Weathered rock
9000 to 16,000	Unweathered rock

Plates 12 and 13 show the interpretation of the results of the seismic survey in the form of profiles indicating the thickness of the overburden. Cross-sections A and X (Plate 12) were obtained using the broadside-shooting technique; cross-sections along the river (Plate 13) were calculated by the 'method of differences'.

It is very difficult to assess the accuracy of the seismic survey results, especially where the overburden is very thin and uneven. Table 9 shows a comparison between the thickness of overburden from drilling and from seismic data.

TABLE 9

Station	Drill Hole No.	Depth from drilling (ft)	Rock type	Depth from seismic data	Seismic velocity (ft/sec)
A11	6611	0 - 20	Weathered porphyry	0 - 20	
		20 - 27	Mainly sound rock	20 -	14,000
		27 -	Sound rock		
			Total depth 60 ft		
A10	6612	0 - 60	Mainly sound, weathered joints	0 - 23	14,000
		60 -	sound rock	23 -	
			Total depth 78 ft		
A6	6613	0 - 23	weathered joints	0 - 20	
		23 -	mainly sound rock	20 -	16,000
			Total depth 47 ft		
A15	6614	0 - 12	Talus material	0 - 12	
		12 -	Sound rock, weathered joints	12 -	16,000
			Total depth 55 ft		
A18	6615	0 - 20	Talus material	0 - 51	
		20 - 36	weathered rock	51 -	11,000
		36 -	sound rock		
			Total depth 46 ft		

Conclusions

The geophysical survey provided information on the depth to the bedrock at the Murchison No. 4 Dam site. The overburden consists of talus material; the maximum thickness estimated from seismic data is 89 ft near station F5.

The velocity in the bedrock ranges from 9000 to 16,000 ft/sec.

8. BOCO SADDLE DAM SITE

Introduction

The geophysical survey on the proposed Boco Saddle dam site was made to ascertain whether the water from the Pieman River would be likely to leak into the Boco Creek.

Geology

Plate 14 shows the geology of the area. The whole area of the survey is covered with gravel. Two drill holes have been put down by HEC proving the thickness of gravel to be in excess of 74 ft (DDH 6426 was abandoned in gravel at the depth of 74 ft). Massive pyroclastic rock crops out along the Pieman River, in the Boco Creek, and near the tramline from Farrell Junction to Tullah.

Seismic and resistivity results

Plate 14 shows the arrangement of seismic traverses. Table 10 gives seismic wave velocities on the Boco Saddle dam site.

TABLE 10

Seismic velocity (ft/sec)	Rock type
1000	Soil
5000	Gravel
5000 to 9000	Weathered bedrock
9000 to 15,000	Unweathered bedrock

On Plate 15 the cross-section along the main traverse is shown. The cross-section indicates the great thickness of low-velocity (5000 ft/sec) material, reaching a maximum thickness of 213 ft at stations A20 and A21. Resistivity profiles may be expected to indicate high values over shallow bedrock. The values should decrease with an increase in the thickness of overburden. Local increase in resistivity near stations A10 A22, and A26 may be due to buried peaks of weathered bedrock. It has been concluded that gravel and weathered bedrock have similar seismic velocities and therefore cannot be distinguished by seismic work.

The cross-sections along Traverses C, D, E, and F are shown on Plate 16.

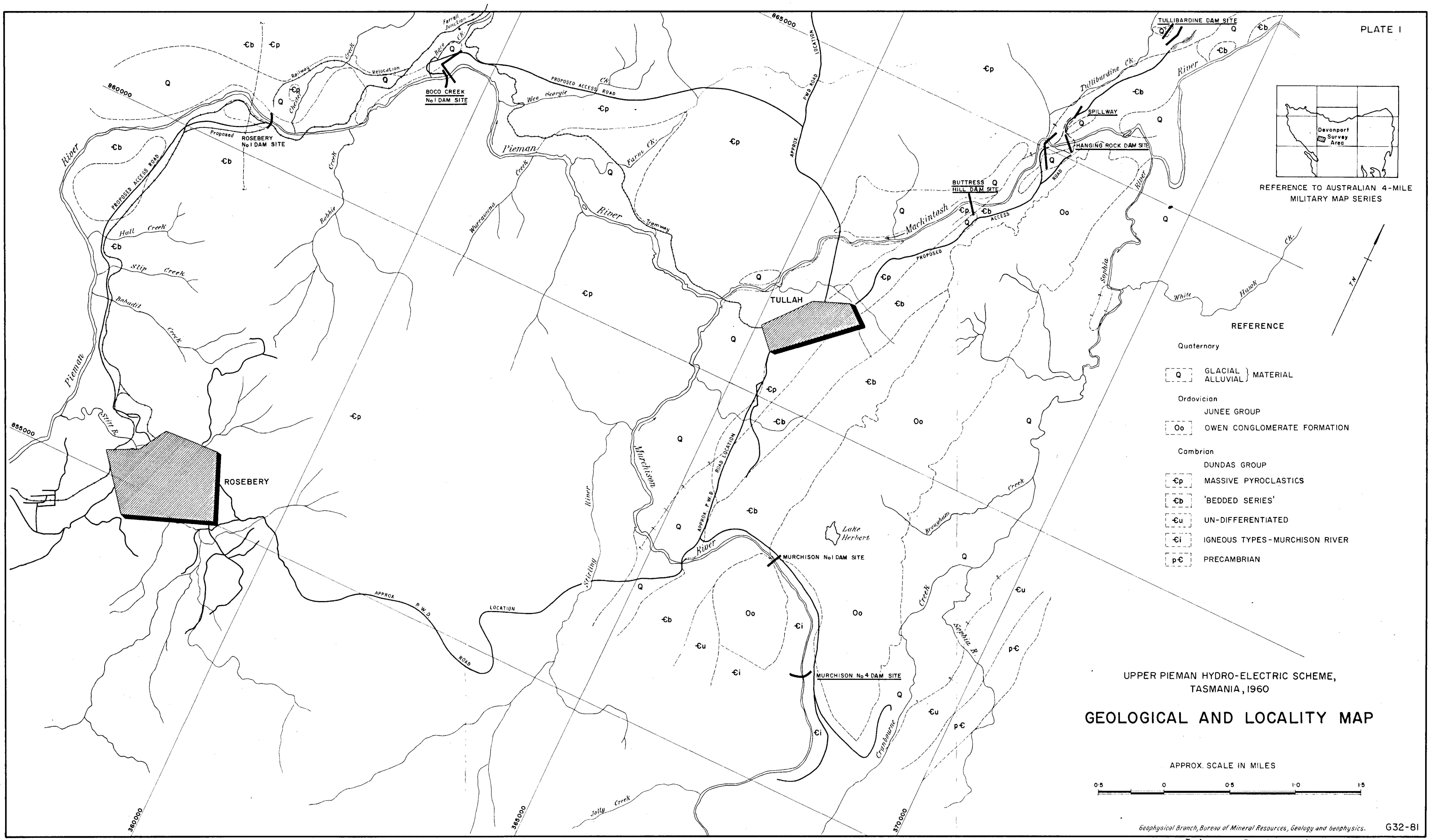
Plate 14 shows also the contours of the surface of unweathered rock. The contours indicate the course of the old river, shown with arrows on the plate.

Conclusions

The geophysical survey at the Boco Saddle dam site indicates a great thickness of low-velocity rocks. Rocks with such a low velocity may be expected to have high porosity, and therefore the water would be likely to leak from the reservoir into the Boco Creek.

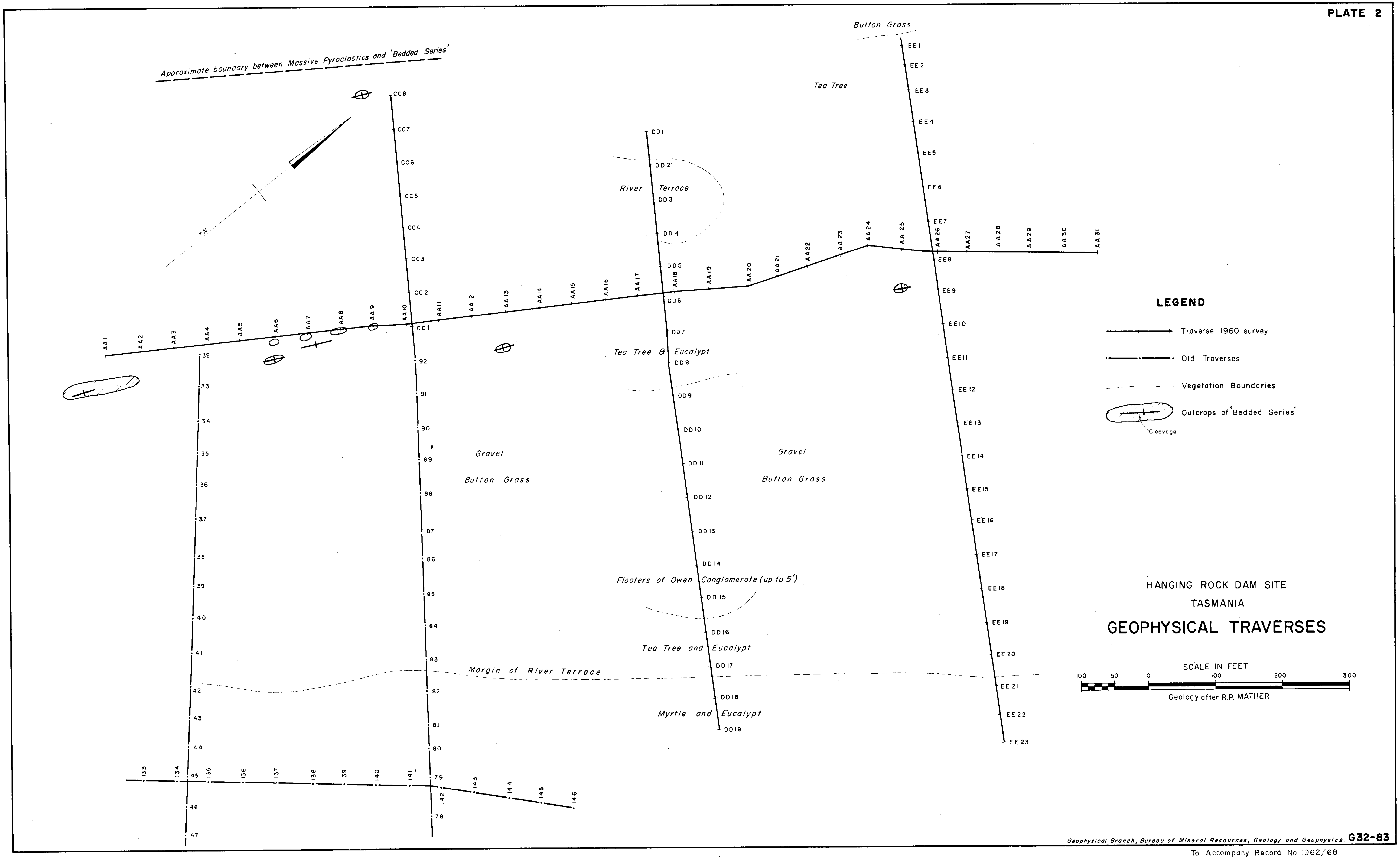
9. REFERENCES

BRADLEY, J.	1954	The geology of the West Coast Range of Tasmania, Pt. 1. Papers and Proc. Roy. Soc. Tas., 88
BRADLEY, J.	1956	Idem, Pt. 2, Ibid. 90
DYSON, D.F. and BAMBER, B.J.	1959a	Mackintosh River dam site geophysical survey, Tasmania. Bur. Min. Resour. Aust. Record 1959/148.
DYSON, D.F. and BAMBER, B.J.	1959b	Geophysical investigations at the Rosebery No. 1 dam site, Tasmania. Bur. Min. Resour. Aust. Record 1959/85.
HEILAND, C.A.	1946	GEOPHYSICAL PROSPECTING. Prentice Hall Inc., New York.
MATHER, R.P.	1959	Geological plans. (Unpublished).
OPIK, A.A.	1951	Notes on the stratigraphy and palaeontology of Cambrian, Ordovician and Silurian rocks of Tasmania. Bur. Min. Resour. Aust. Record 1951/5.
POLAK, E.J.	1957a	Seismic refraction survey of the Murchison River dam site, Tasmania. Bur. Min. Resour. Aust. Rec. 1957/59
POLAK, E.J.	1957b	Geophysical investigations at the Mackintosh River dam site Tasmania. Bur. Min. Resour. Aust. Record 1957/60.
POLAK, E.J. and MOSS, F.J.	1959	Geophysical survey at the Cluny dam site, Derwent River, Tasmania. Bur. Min. Resour. Aust. Record 1959/87.
WARD, L.K.	1908	The Mount Farrell Mining Field. Tas. Dept. of Mines, Geol. Survey, Bull. 3.



To Accompany Record No.1962/68

UPPER PIEMAN, TAS.



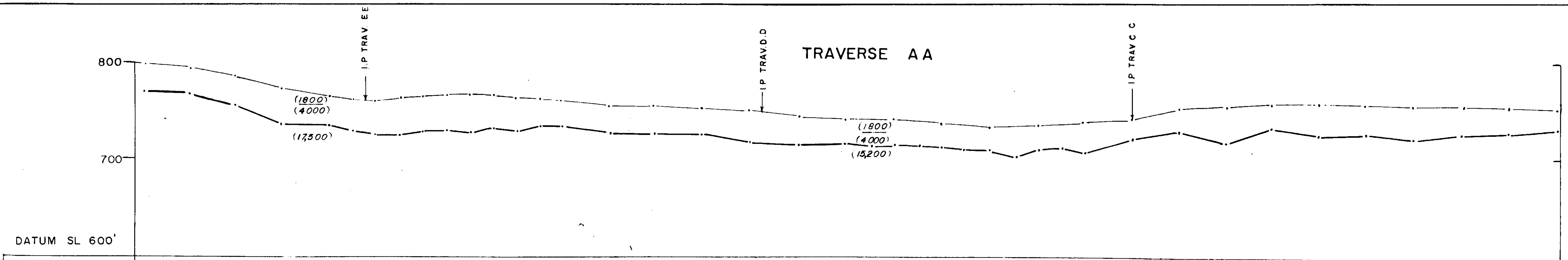
HANGING ROCK DAM SITE
TASMANIA
GEOPHYSICAL TRAVERSES

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. G32-83

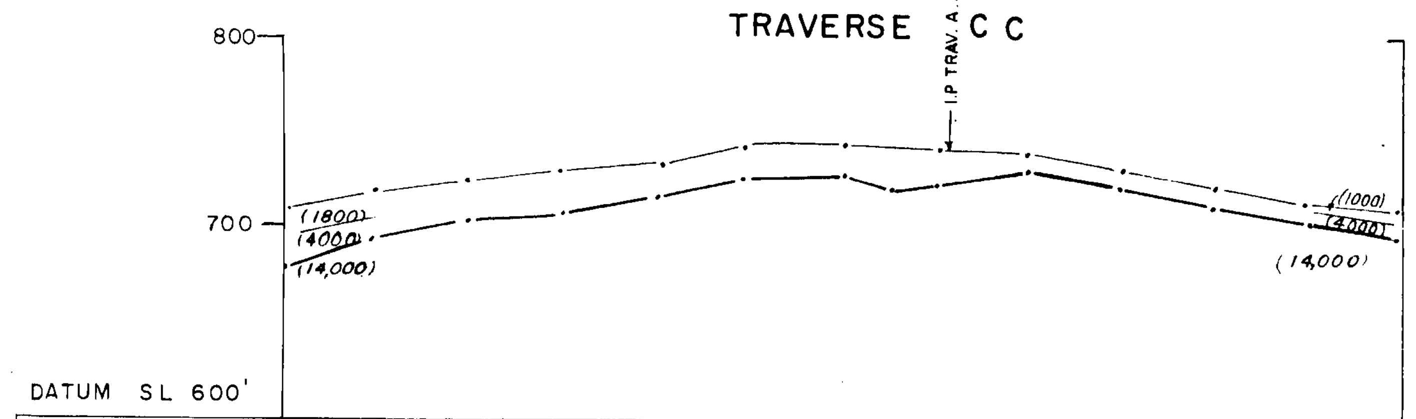
To Accompany Record No 1962/68

UPPER PIEMAN HYDRO ELECT. TAS.

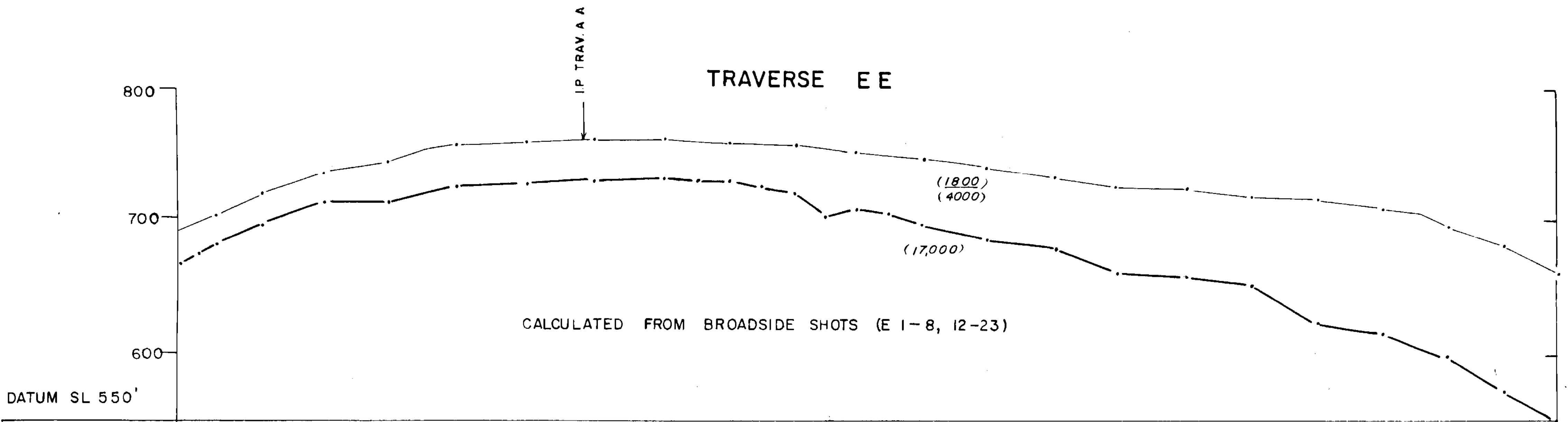
PLATE 3



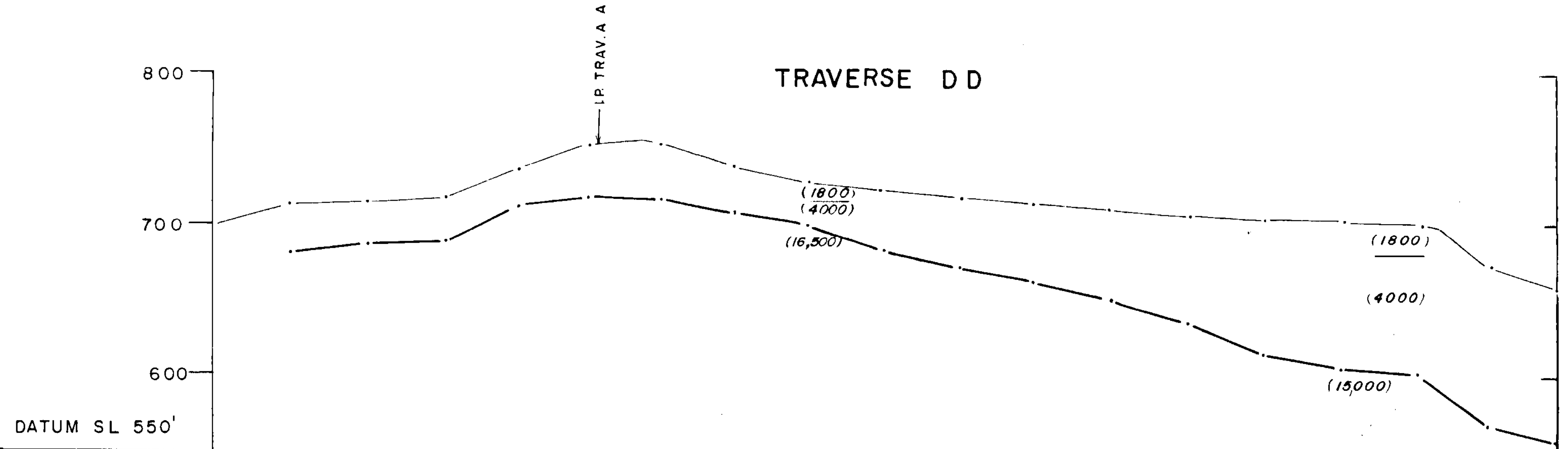
Traverse AA	
STATION NUMBER	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1
STATION ELEVATION	799 798 795 786 772 764 761 765 767 766 761 756 756 756 755 751 749 746 743 743 741 735 737 740 742 743 754 759 759 759 758 758 757 755 759
DEPTH TO BEDROCK	27 25 28 35 29 31 32 37 35 36 39 37 32 34 26 25 26 27 25 31 27 22 26 25 24 24 24 22 30 23 24 31 19 23 39 23 32 30 33 29 25 21



Traverse CC	
STATION NUMBER	8 7 6 5 4 3 2 1 92 91 90 89 88
STATION ELEVATION	708 717 724 729 733 743 747 745 742 743 734 732 724 717 712
DEPTH TO BEDROCK	28 22 18 21 16 15 17 21 19 6 8 10 11 13



Traverse EE	
STATION NUMBER	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
STATION ELEVATION	693 706 721 733 737 745 754 757 759 761 761 761 758 757 756 752 747 741 733 726 723 718 716 715 709 705 698 681 661
DEPTH TO BEDROCK	27 23 23 24 21 31 31 31 31 29 29 29 32 36 50 43 43 49 55 54 63 65 67 95 94 98 111 112



Traverse DD	
STATION NUMBER	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
STATION ELEVATION	698 712 713 717 735 749 751 755 755 753 737 727 722 718 713 710 707 706 704 703 701 699 674 660
DEPTH TO BEDROCK	32 26 29 23 31 37 29 28 39 46 50 59 70 89 96 99 105 102

HANGING ROCK DAM SITE

TRAVERSES AA, CC, EE, AND DD

CROSS - SECTIONS

HORIZONTAL AND VERTICAL SCALES IN FEET
100 0 100 200 300

GEOPHYSICAL BRANCH, BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS G 32-86

To Accompany Record No 1962/68

UPPER PIEMAN TAS. 1960


GRAVEL
Button Grass
GRAVEL WITH SCATTERED FLOATERS OF OWEN CONGLOMERATE
MYRTLE GRAVEL
Tall Tea Tree
Top of slope
TRAVERSE L
TRAVERSE K
TRAVERSE J
TRAVERSE F
TRAVERSE E
TRAVERSE D
TRAVERSE C
TRAVERSE X
TRAVERSE A
CABLE WAY
TRACK
DDH 6523
DDH 6524
DDH 6522
DDH 6525
DDH 6526
MACKINTOSH RIVER
Button Grass and some low Tea Tree
Button Grass
GRAVEL
Possible outcrop of massive Pyroclastics
Tea Tree Fine Grass
MASSIVE PYROCLASTIC TALUS MATERIAL
Tea Tree and Button Grass
Tall Tea Tree and Baveria
MYRTLE GRAVEL
Creek
TALUS MATERIAL and scattered outcrops of massive Pyroclastics
Top of Slope
Button Grass
Small Creek
MASSIVE PYROCLASTICS BENEATH GRAVEL
Approximate position of boundary concealed by gravels
BEDDED SERIES (FARREL SLATES) BENEATH GRAVEL
Button Grass
Boundary thought to have steep dip to West
Approximate position of fault zone (Probably of wide extent)
TALUS MATERIAL
Depression
To Hanging Rock
To Tullah
N
LEGEND
Outcrops of massive Pyroclastics
Outcrop of Owen Conglomerate
Vegetation boundary
DDH 6524 Diamond-drill hole No 6524
BUTTRESS HILL DAM SITE
GEOLOGY AND TRAVERSES
GEOLOGY AFTER R.P. MATHER
SCALE IN FEET
100 0 100 200 400

PLATE 5

BUTTRESS HILL DAM SITE

TRAVERSES A AND X

PROFILES AND CROSS-SECTIONS

HORIZONTAL AND VERTICAL SCALES IN FEET

DATUM SL 300'

Traverse A

STATION NUMBER	STATION ELEVATION	DEPTH TO BEDROCK
1	803	96
2	785	90
3	772	103
4	765	111
5	755	115
6	747	104
7	738	109
8	730	100
9	722	78
10	710	100
11	703	119
12	696	105
13	691	88
14	684	77
15	679	81
16	676	79
17	674	64
18	675	55
19	677	48
20	676	46
21	673	51
22	664	72
23	643	65
24	623	53
25	604	65
26	568	30
27	529	52
28	509	15
W.L	490	
W.L	490	
W.L	492	
29	501	6
30	515	53
31	541	87
32	565	117
33	589	135
34	612	125
35	632	193
36	655	198
37	680	171
38	696	166
39	704	158
40	707	157
41	708	106
42	706	125
43	711	60
44	712	48
45	700	36
46	721	48
47	730	51
48	740	34
49	747	39

Traverse X

STATION NUMBER	STATION ELEVATION	DEPTH TO BEDROCK
1	801	113
2	783	101
3	768	69
4	759	88
5	749	105
6	739	90
7	731	86
8	725	107
9	720	109
10	712	109
11	709	109
		130
12	700	105
		95
13	695	90
14	687	107
15	686	99
16	687	95
17	681	88

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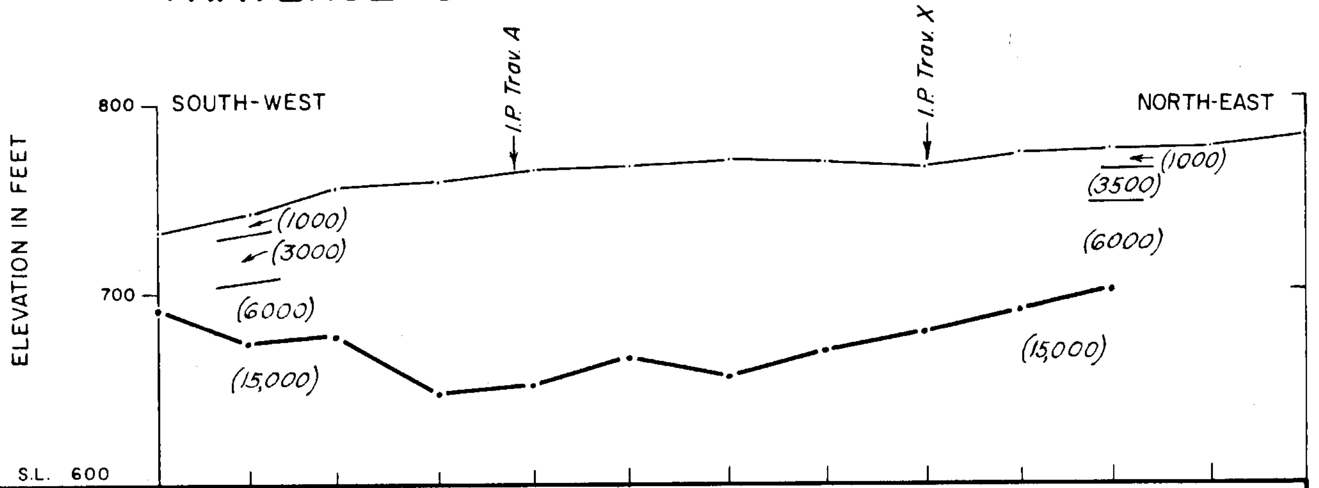
UPPER PIEMAN TAS. 1960

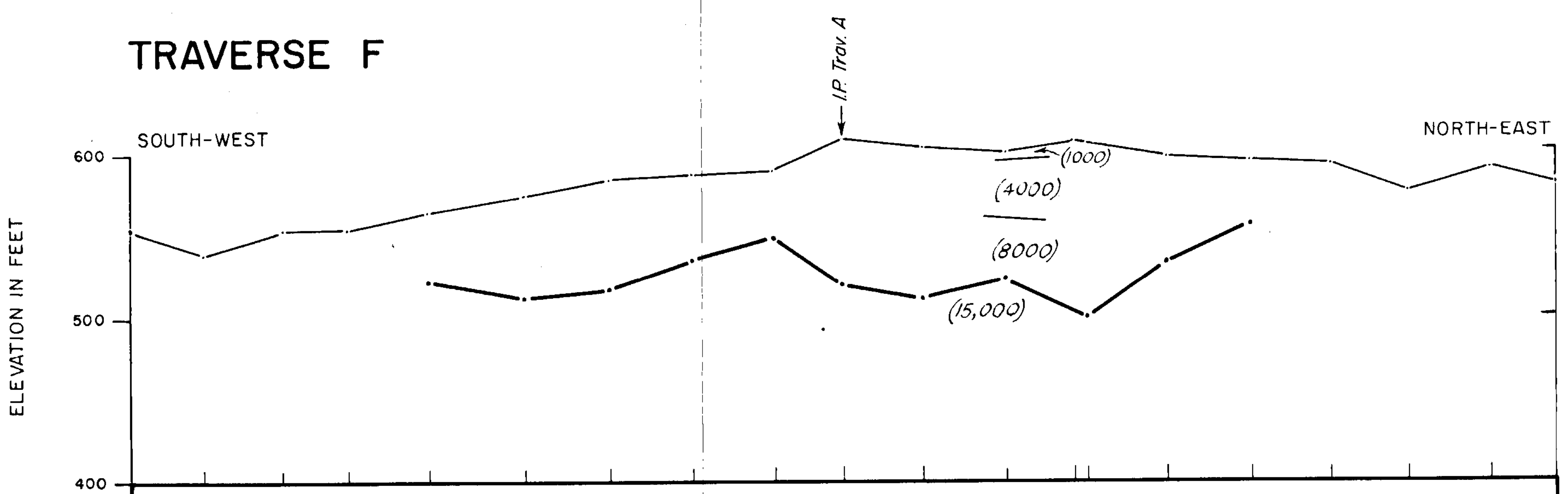
To Accompany Record No. 1962/68

TRAVERSE C



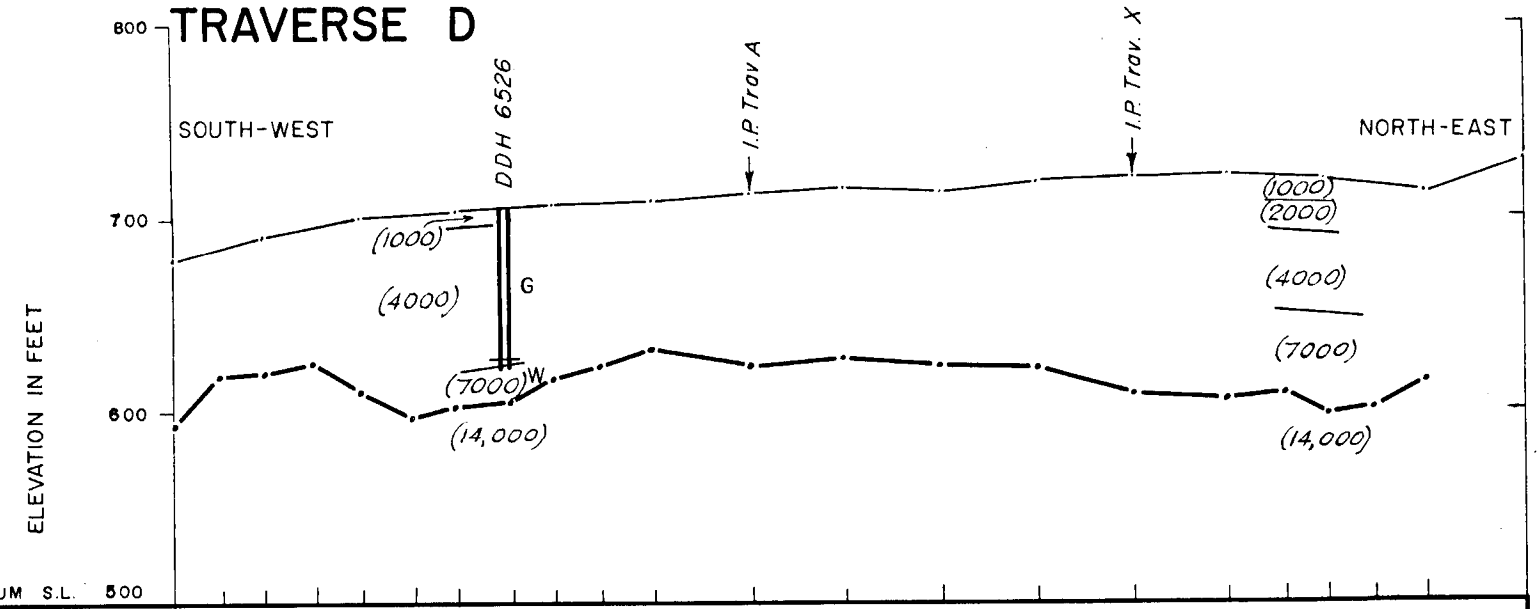
SURFACE LEVEL	732·9	741·7	757·4	760·3	766·9	768·2	771·8	770·9	768·3	775·3	778·0	777·8	780·7
STATION No.	C13	C12	C11	C10	C9 (A4)	C8	C7	C6	C5 (X3)	C4	C3	C2	C1
DEPTH TO BEDROCK	39	66	76	109	111	98	111	98	84	80	72		

TRAVERSE F



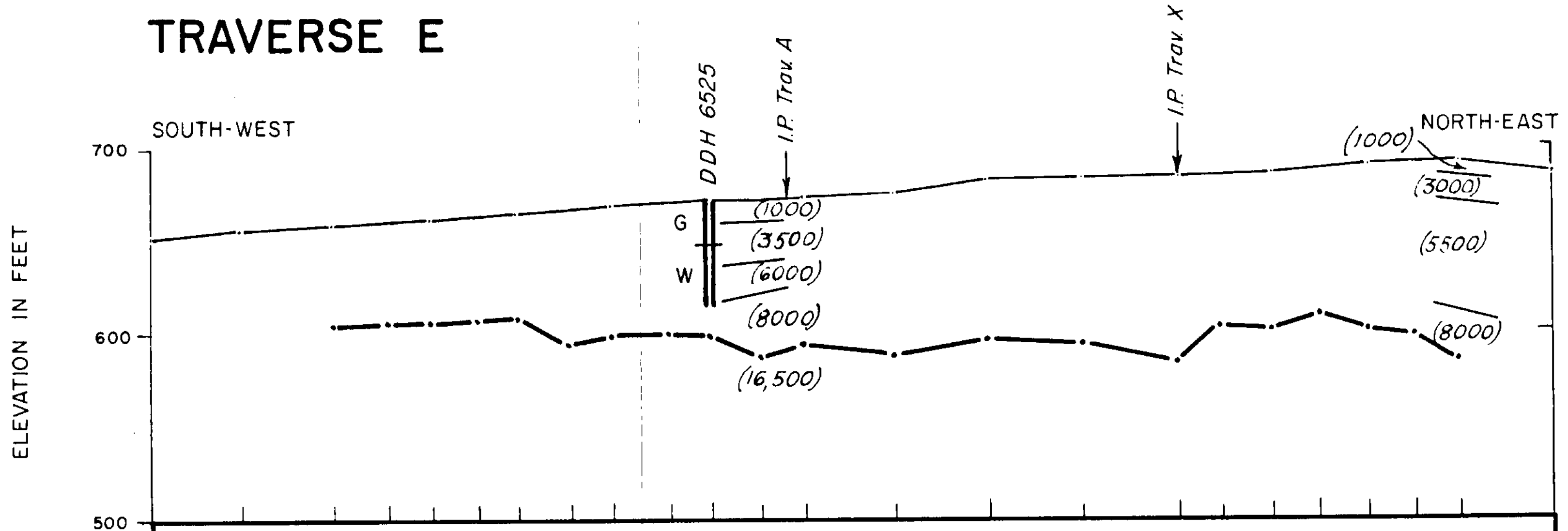
SURFACE LEVEL	552·3	538·0	552·0	553·5	552·5	574·5	583·3	586·0	589·3	609·0	607·8	599·8	607·1 606·3	597·5	594·2	592·6	575·8	590·1	579·5
STATION No.	F19	F18	F17	F16	F15	F14	F13	F12	F11	F10 (A25)	F9	F8	F7	F6	F5	F4	F3	F2	F1
DEPTH TO BEDROCK					45	63	70	53	45	90	95	78	110	63	40				

TRAVERSE D



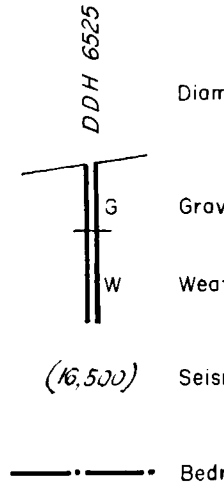
SURFACE LEVEL	675·7	690·0	699·6	703·4	704·6	706·1	707·4	710·5	714·5	712·4	718·1	720·4	721·0	718·3	711·8	729·0						
STATION No.	D15	D14	D13	D12	D11	D10	D9 (A10)	D8	D7	D6	D5 (X9)	D4	D3	D2	D1							
DEPTH TO BEDROCK	83	63	70	70	92	105	101	101	88	86	76	88	88	90	97	114	117	112	122	117	97	

TRAVERSE E



SURFACE LEVEL	657·3	661·5	663·3	667·7	670·6	672·9	675·6	679·0	685·3	687·3	687·4	689·8	694·2	695·0	689·9							
STATION No.	E16	E15	E14	E13	E12	E11	E10	E9 (A16)	E8	E7	E6	E5 (X14)	E4	E3	E2	E1						
DEPTH TO BEDROCK	54	54	56	54	54	70	68	68	70	81	79	87	84	88	99	80	83	78	88	92	103	

LEGEND

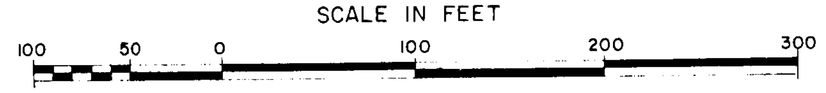


BUTTRESS HILL DAM SITE

TRAVERSES C,D,E and F

CROSS–SECTIONS

SCALE IN FEET



UPPER PIEMAN, TASMANIA.

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics.

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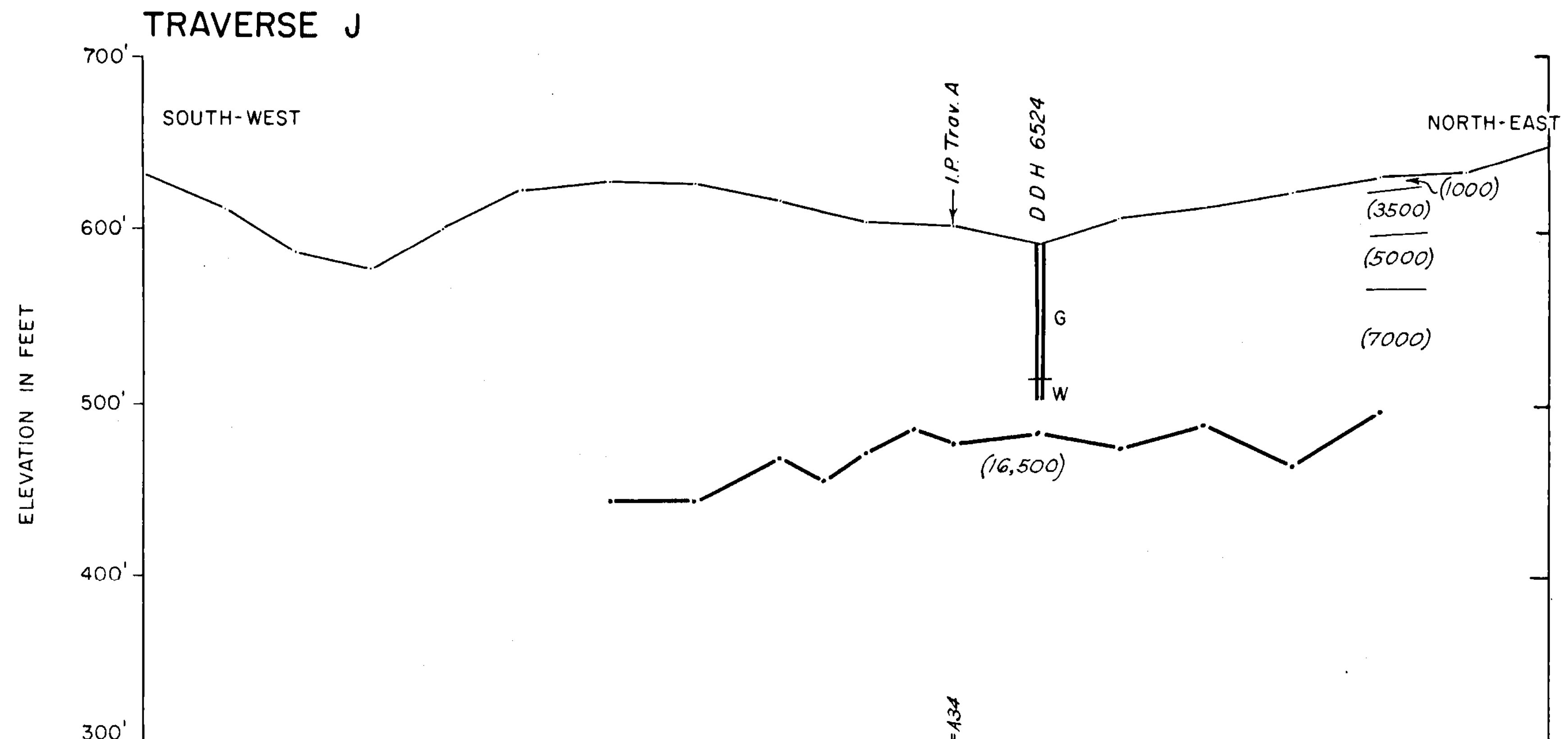
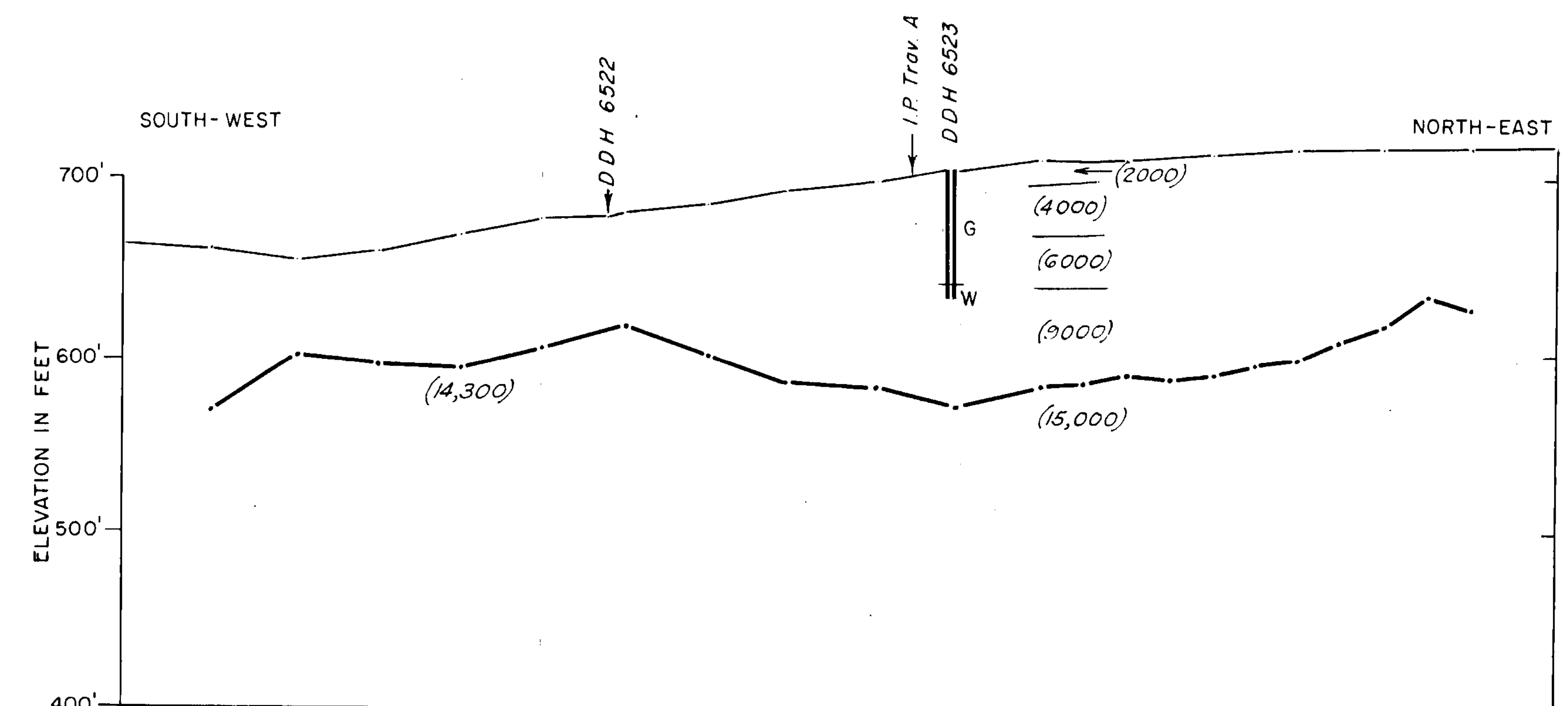
To Accompany Record No. 1962/68

TRAVERSE J



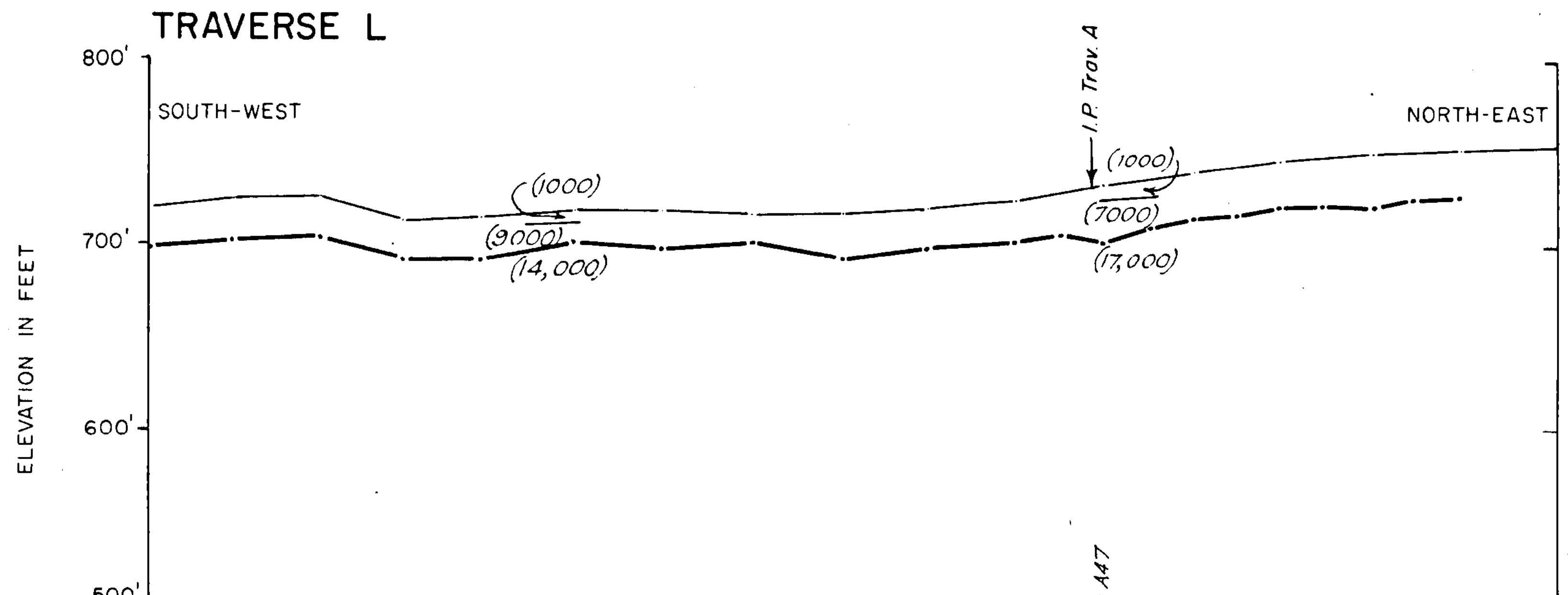
STATION NUMBER	J18	J17	J16	J15	J14	J13	J12	J11	J10		J9		J8 (=A34)	J7	J6	J5	J4	J3	J2	J1
STATION ELEVATION	631·2	610·4	584·9	576·2	601·9	621·2	627·4	626·0	616·7		604·4		603·2	592·7	606·8	614·3	628·6	631·3	635·5	650·3
DEPTH TO BEDROCK							183	183	146	154	133	119	125	109	136	125	157	136		

TRAVERSE K



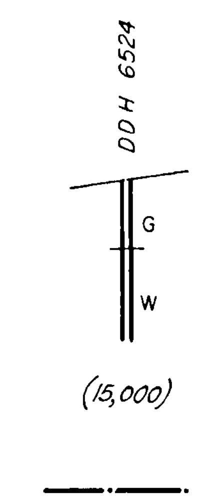
STATION NUMBER	K18	K17	K16	K15	K14	K13	K12	K11	K10	K9	K8	K7		K6		K5		K4		K3		K2	K1
STATION ELEVATION		660·9	654·5	659·3	668·6	677·4	679·4 681·4	684·7	693·7	698·4	707·6	711·4		711·9		713·9		716·4		718·0		718·0	717·9
DEPTH TO BEDROCK		91	59	64	74	74	64	83	108	115	137	133	127	123	127	125	120	118	108	100	83	91	

TRAVERSE L



STATION NUMBER	L17	L16	L15	L14	L13	L12	L11	L10	L9	L8	L7		L6 (=A47)		L5		L4		L3		L2	L1
STATION ELEVATION	727·6	725·2	724·3	713·6	715·7	719·6	719·0	717·2	717·6	720·1	725·0		731·9		740·1		746·0		750·4		754·0	751·9
DEPTH TO BEDROCK	20	21	20	20	20	15	20	14	23	20	26	23	31	25	23	25	25	25	28	25	23	

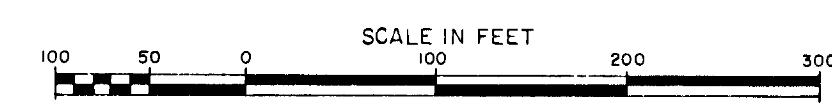
LEGEND



BUTTRESS HILL DAM SITE

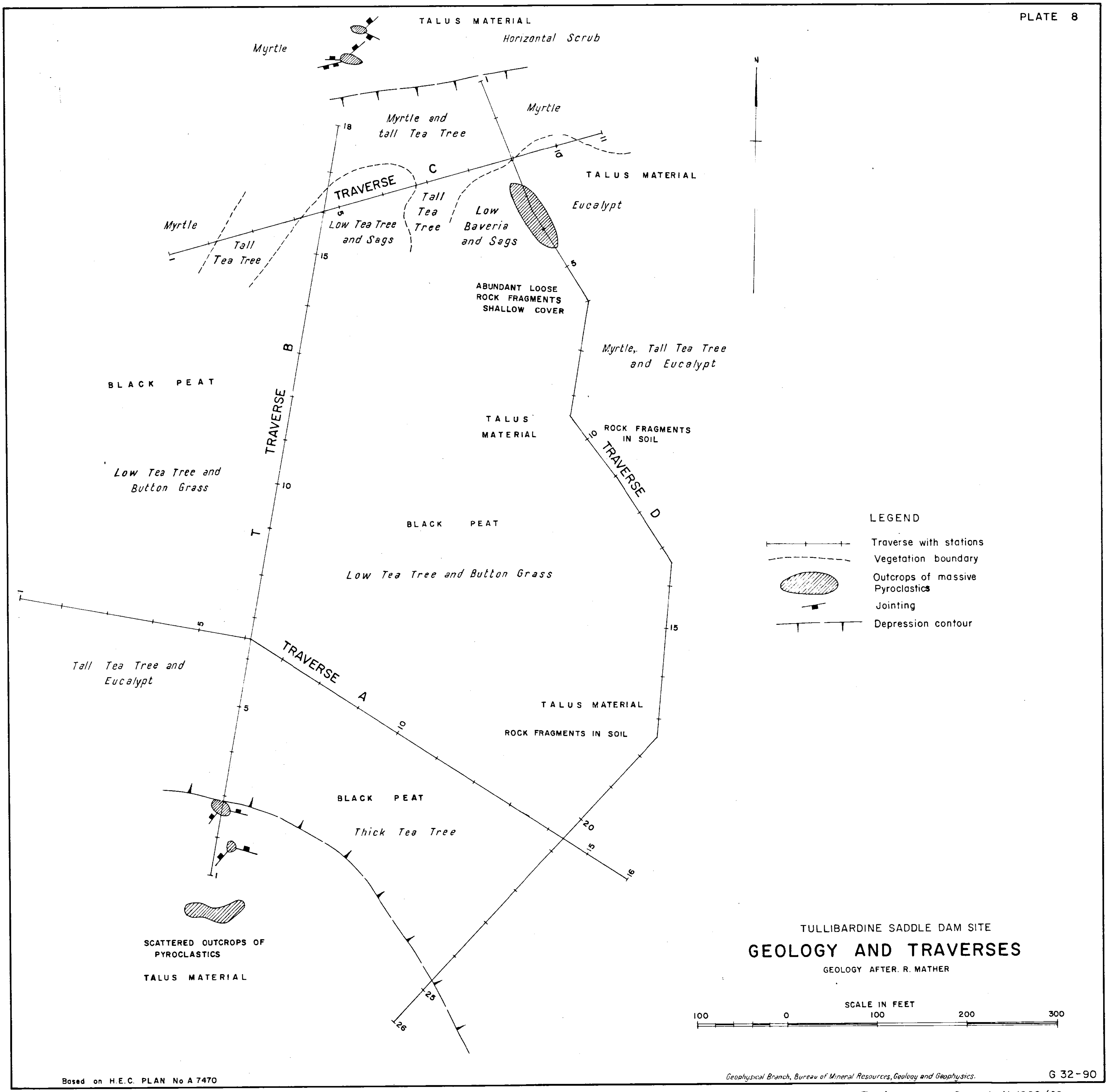
TRAVERSES J, K and L

CROSS-SECTIONS



Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. G32-88

To Accompany Record No. 1962/68



To Accompany Record No1962/68

UPPER PIEMAN, TAS., 1960

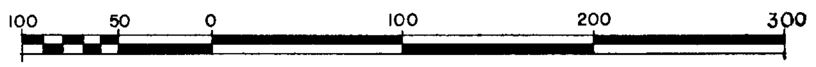
PLATE 9

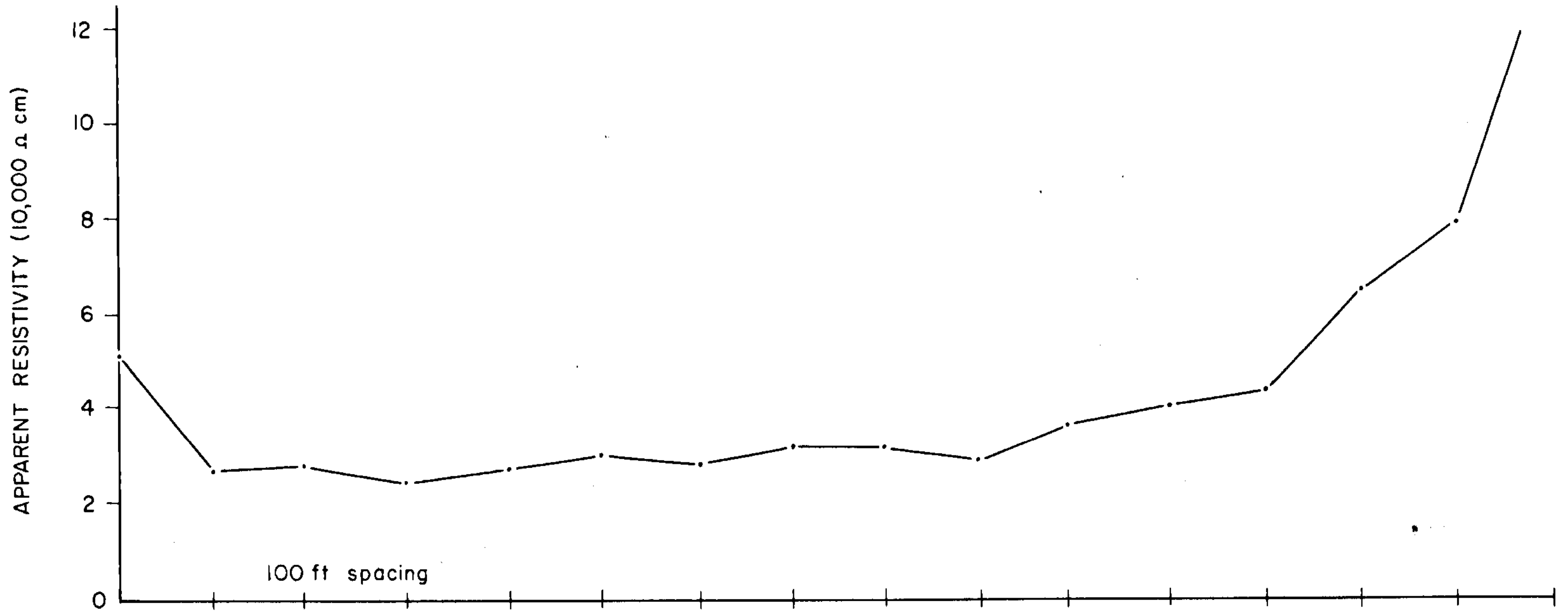
TULLIBARDINE SADDLE DAM SITE

TRAVERSES B and A

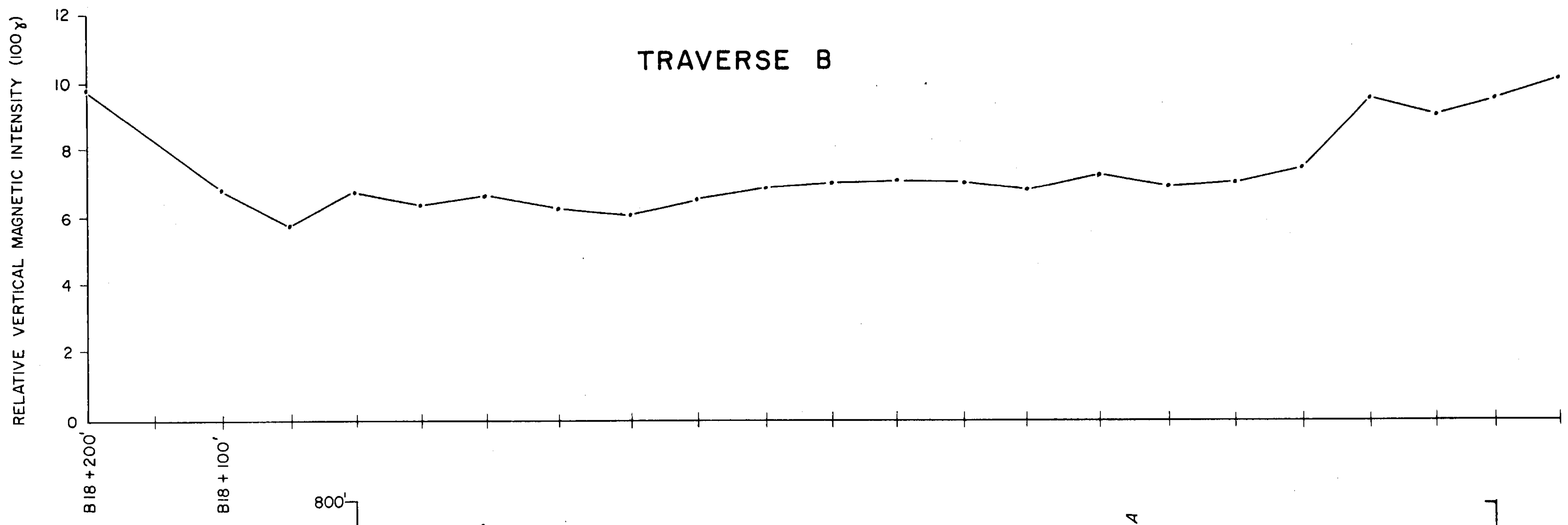
PROFILES AND CROSS SECTIONS

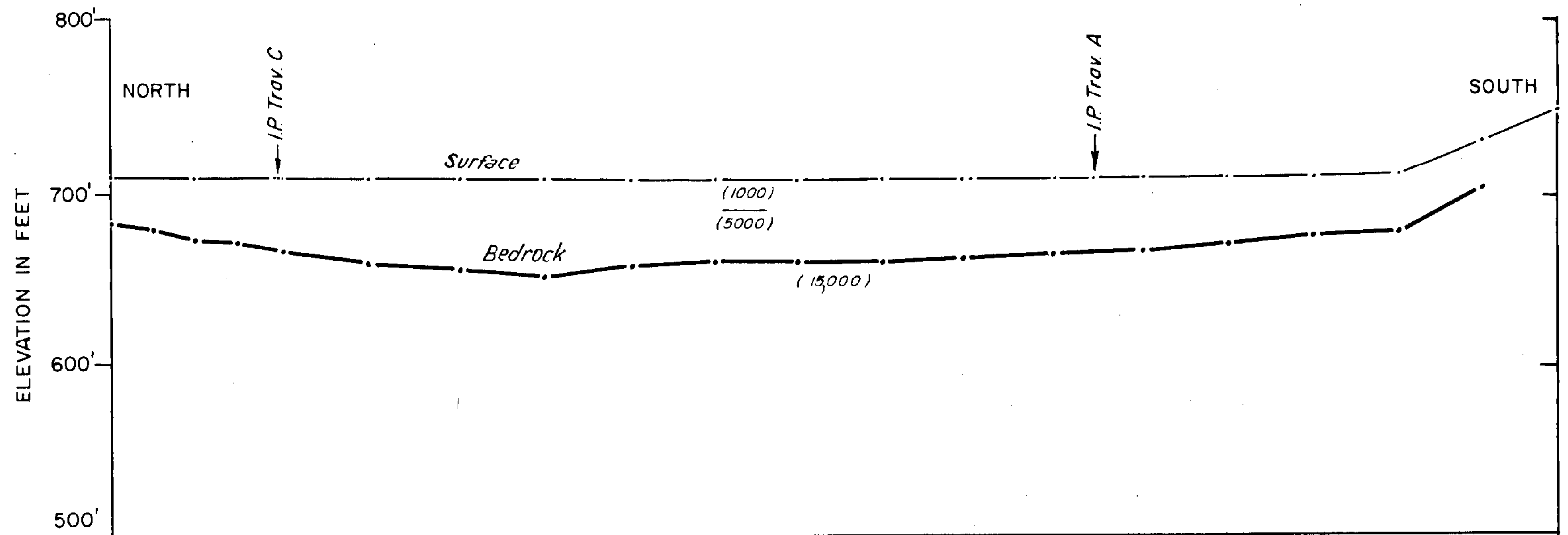
SCALE IN FEET



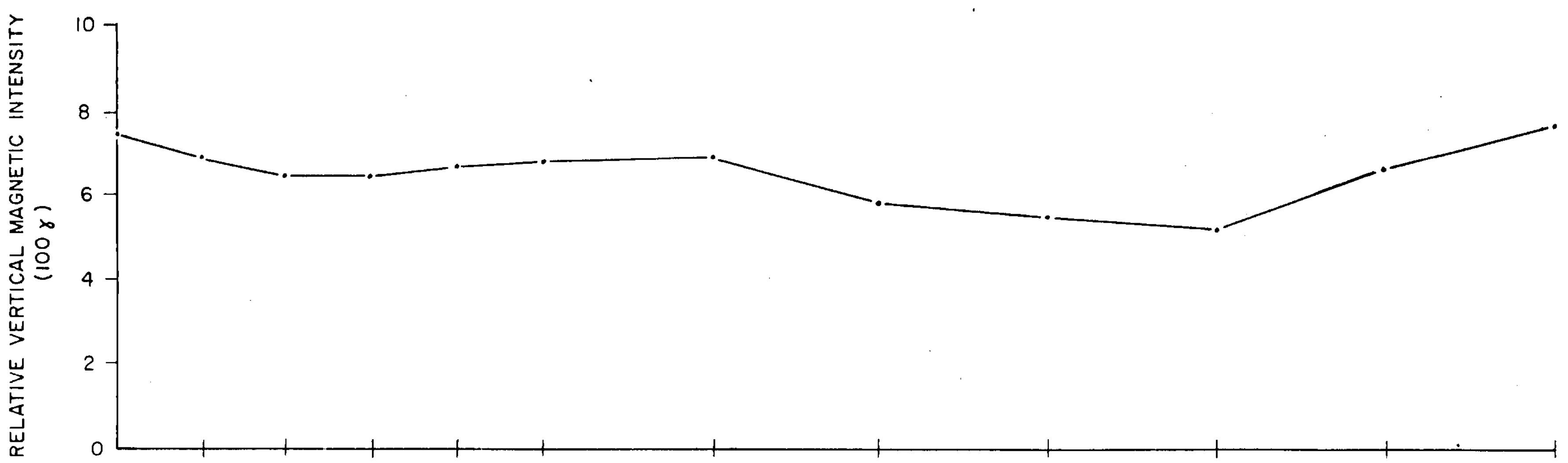


TRAVERSE B

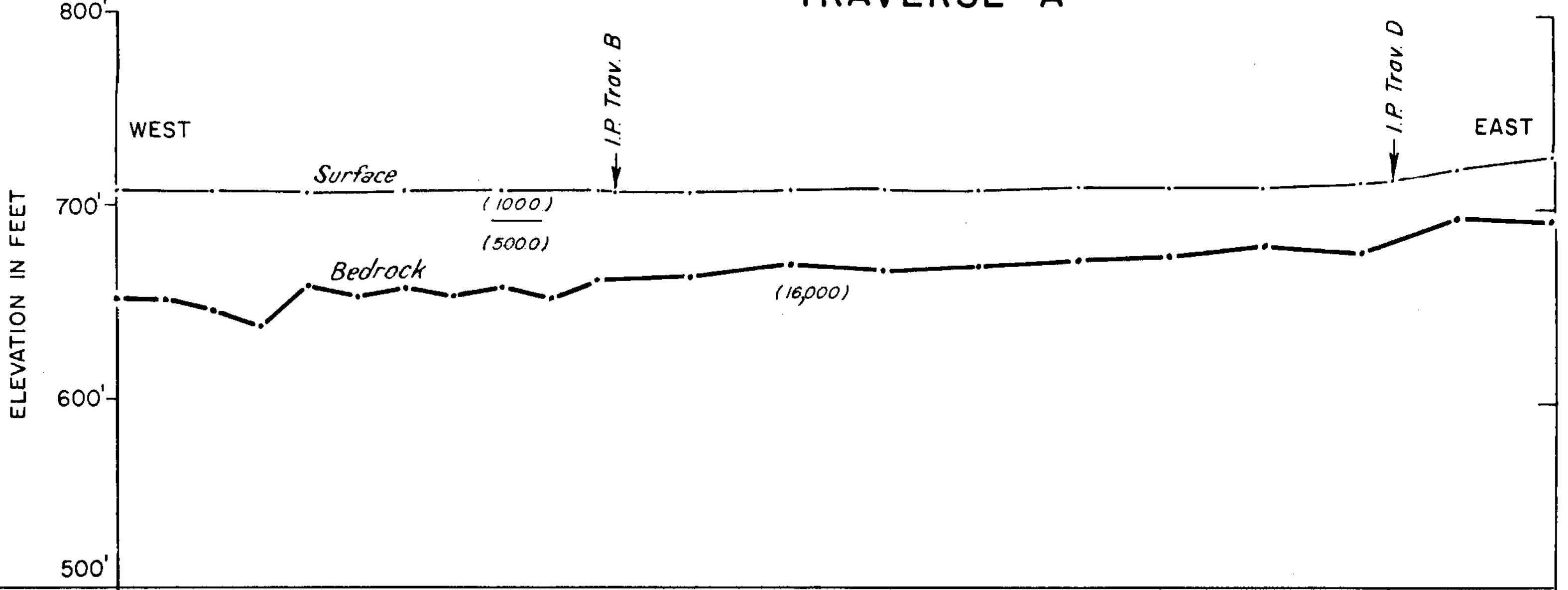




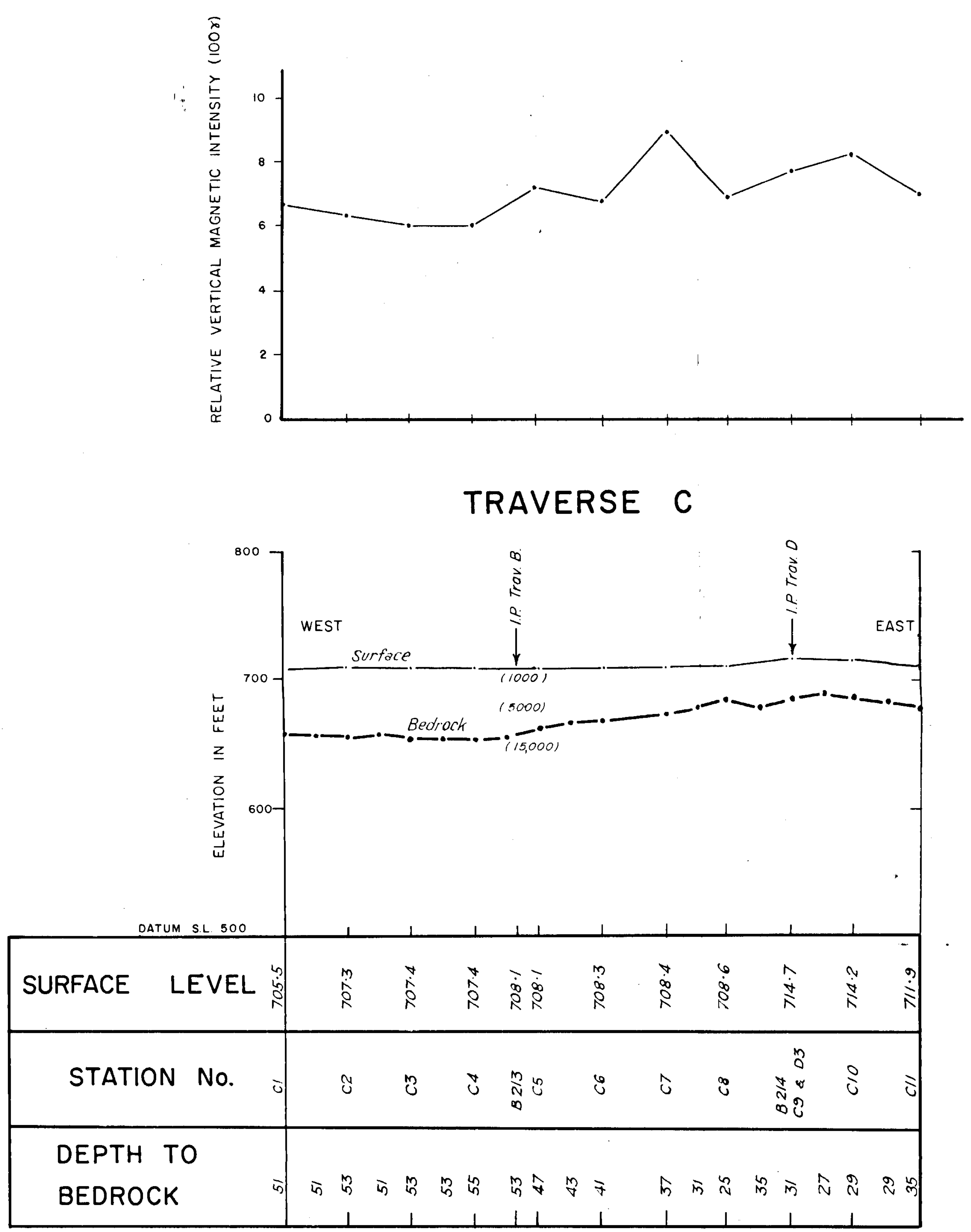
STATION NUMBER	18		17		B213 16	15	14	13	12	11	10	9	8 P66	7	B212	6	5	4	3	2	1
STATION ELEVATION	708		708		708 708	708	707	707	707	706	707	707	707 707	707	707	706	706	707	709	728	746
DEPTH TO BEDROCK	26	29	35	37	42	50	53	56	50	47	49	49	45	44		42	37	33	33	27	

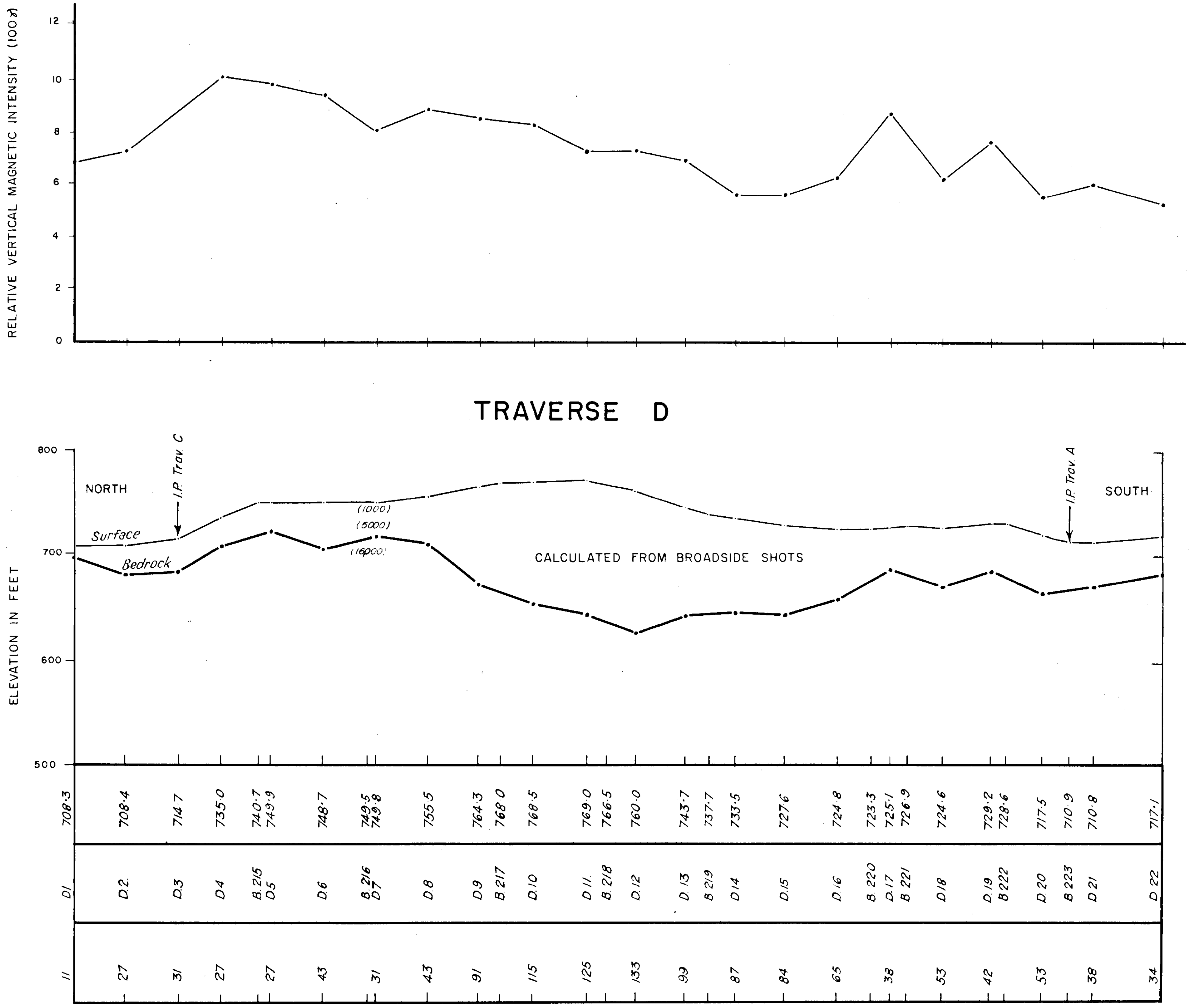


TRAVERSE A



STATION NUMBER	1		2		3		4		5		6 B212	7	8	9	10	11	12	13	14	B223	15	16
STATION ELEVATION	706		707		705		706		707		706 707	706	706	707	706	707	708	708	710	711	717	723
DEPTH TO BEDROCK	56	56	62	69	48	55	51	54	51	56	46	44	38	42	38	38	36	30	36		27	34





TULLIBARDINE SADDLE DAM SITE

TRAVERSES C and D

PROFILES AND CROSS-SECTIONS

SCALE IN FEET

100 50 0 100 200 300

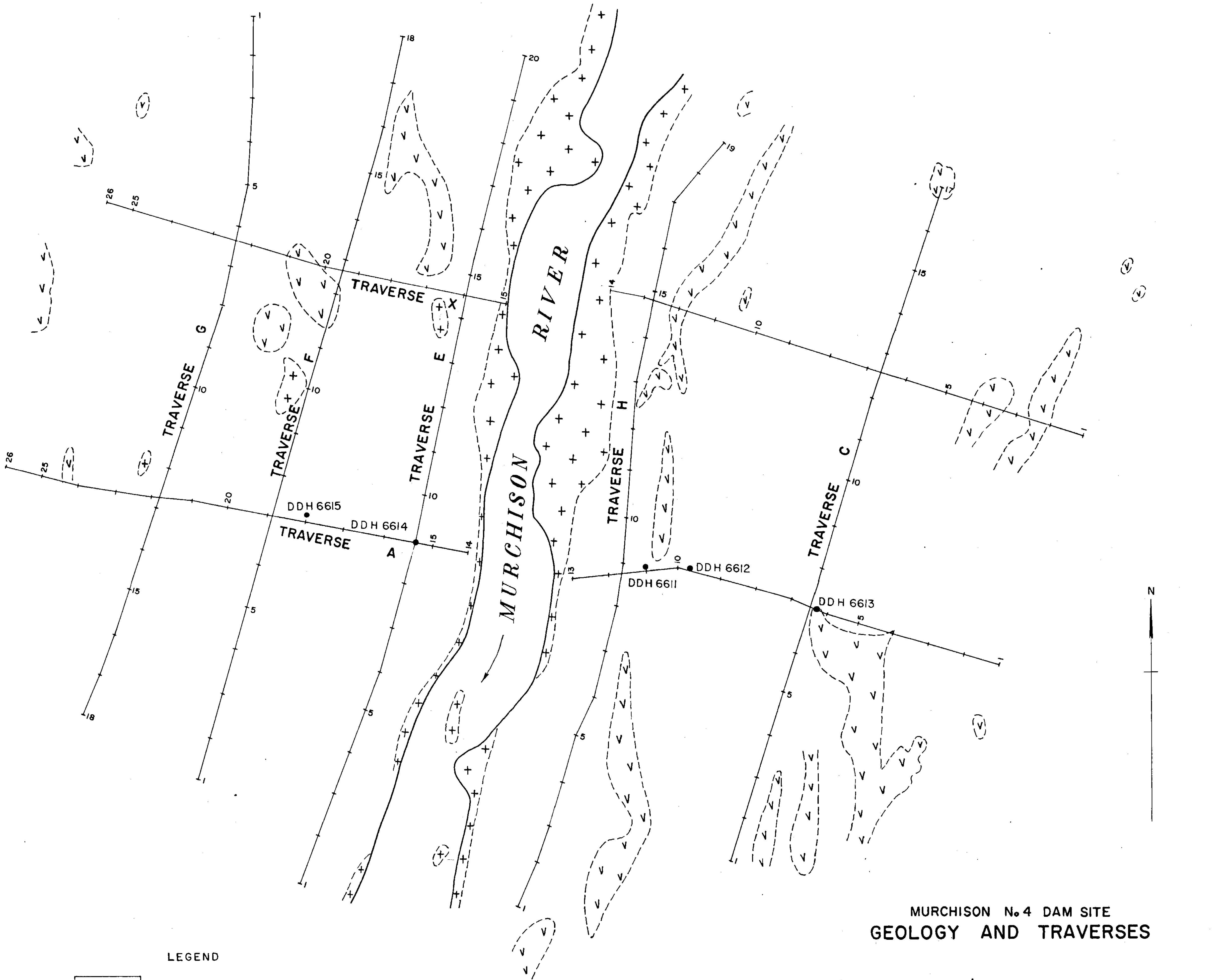
UPPER PIEMAN – TASMANIA

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics.

G 32-92

To Accompany Record No. 1962/68

PLATE 11



MURCHISON No. 4 DAM SITE
GEOLOGY AND TRAVERSES

LEGEND

(blank box)	Talus Material
+ + +	Igneous rocks (Granitic types)
V V V	,, ,, (Porphyry types)
DDH 6614	Diamond-drill hole No. 6614

SCALE IN FEET

100 0 100 200 300

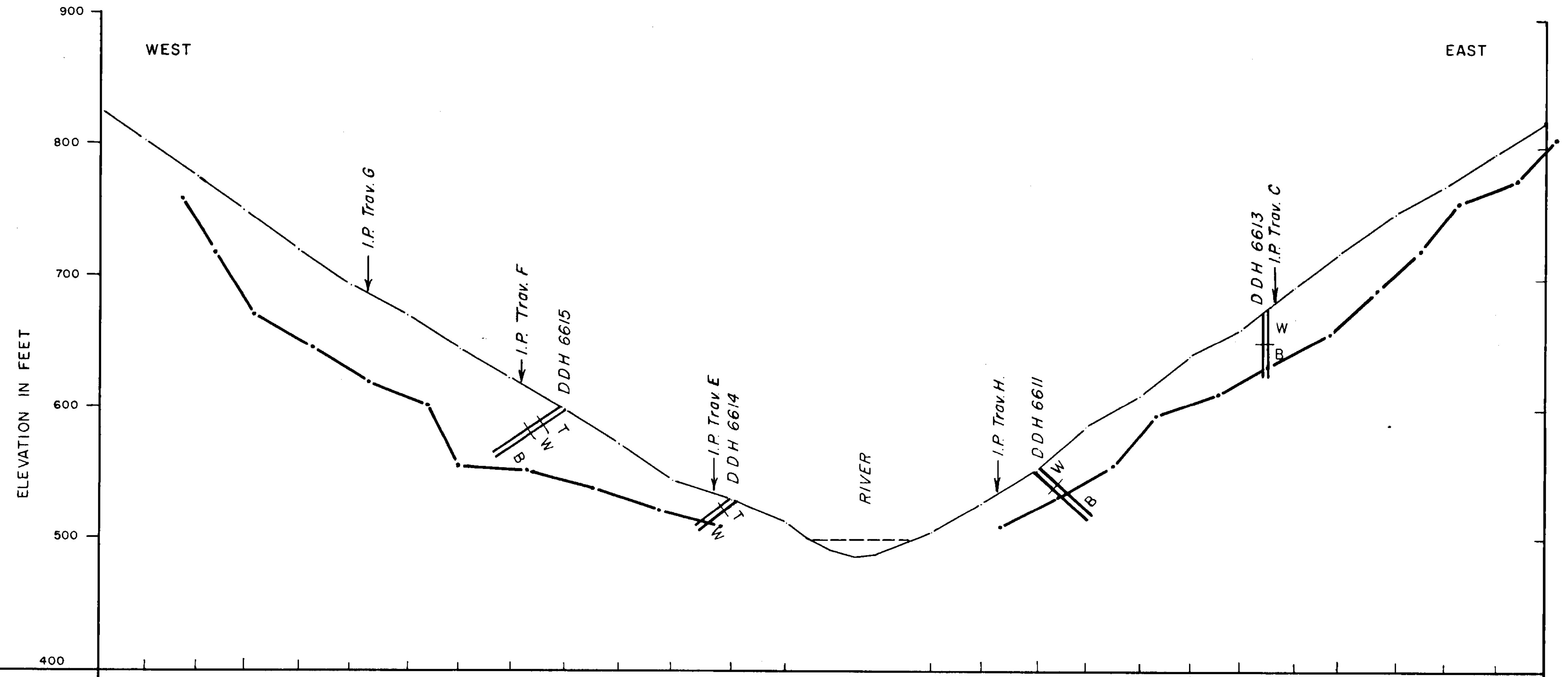
UPPER PIEMAN TAS. 1960

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. G 32-95

To Accompany Record No. 1962/68

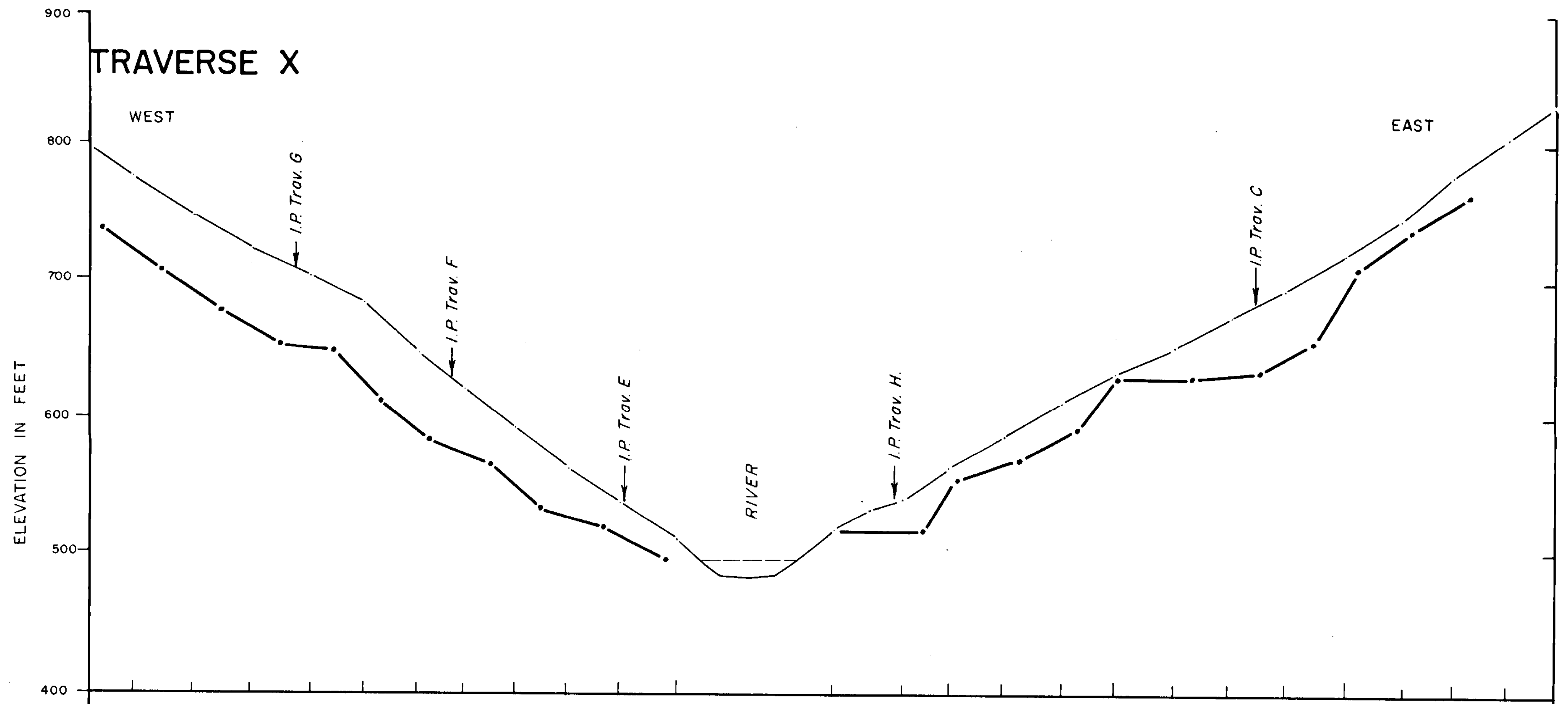
PLATE 12

TRAVERSE A



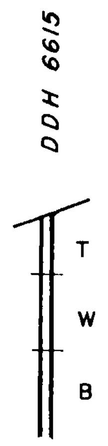
SURFACE LEVEL	804	777	750	719	694	670	647	625	599	572	546	532	512	506	531	546	586	611	642	662	693	719	747	769	793	816
STATION Nº	A26	A25	A24	A23	A22	A21	A20	A19	A18	A17	A16	A15	A14	A13	A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1
DEPTH TO BEDROCK		20	40	60	55	60	50	80	55	40	25	24			23	28	36	20	35	33	44	40	33	17	25	15

TRAVERSE X



778	750	727	707	688	651	625	597	563	544	517	523	542	567	598	615	635	655	676	697	723	749	780	806	829
X25	X24	X23	X22	X21	X20	X19	X18	X17	X16	X15	X14	X13	X12	X11	X10	X9	X8	X7	X6	X5	X4	X3	X2	X1
45	48	51	54	42	45	45	33	36	21	15		26	10	20	24	3	26	48	43	14	10	20		

LEGEND



MURCHISON No. 4 DAM SITE

TRAVERSES A and X

CROSS - SECTIONS

SCALE IN FEET

100 50 0 100 200 300

Calculated from Broadside Shots

Depths plotted normally to the surface

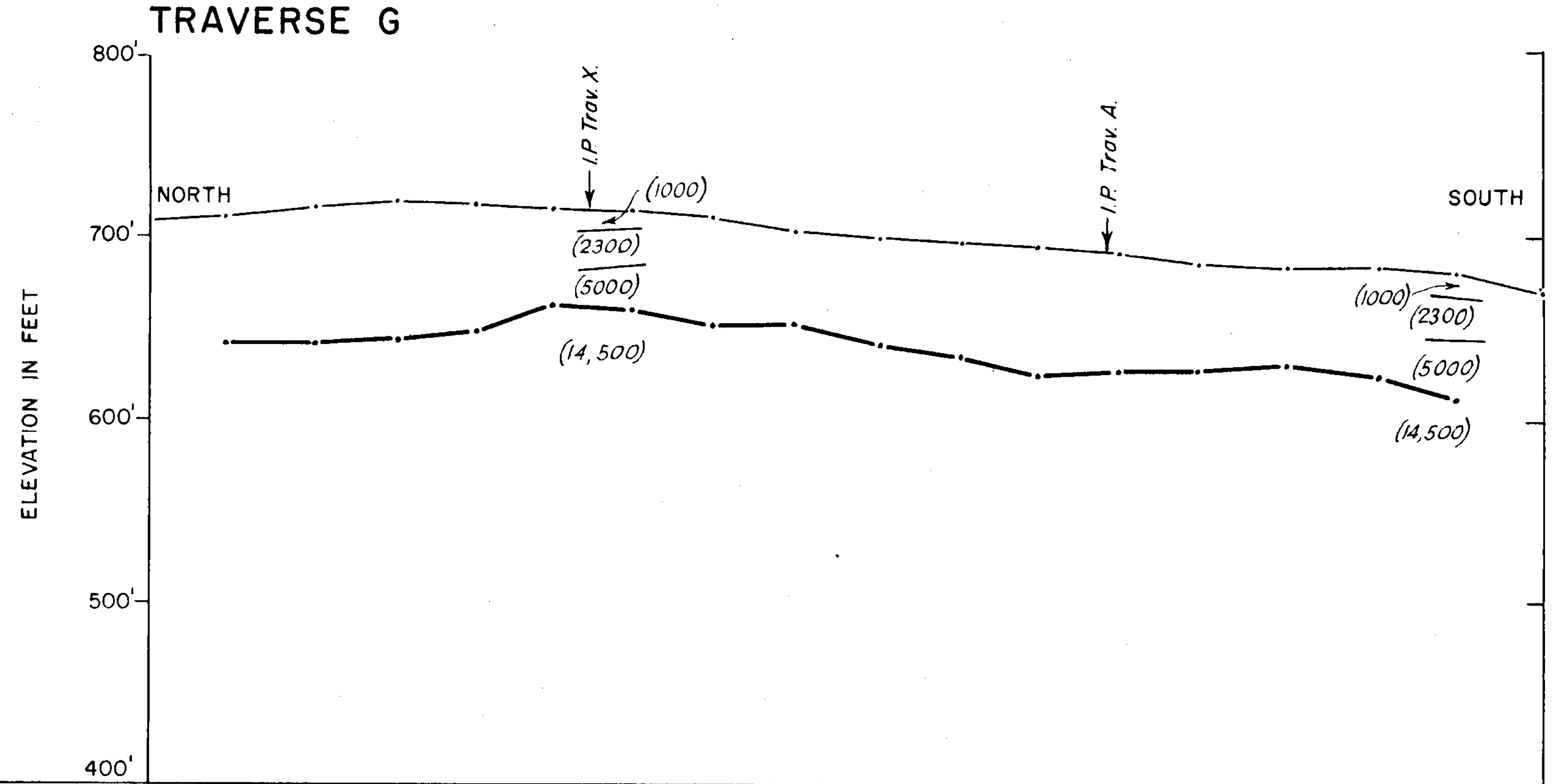
Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics **G32-97**

To Accompany Record No. 1962/68

UPPER HERIAN HYDRO ELEC. TAS

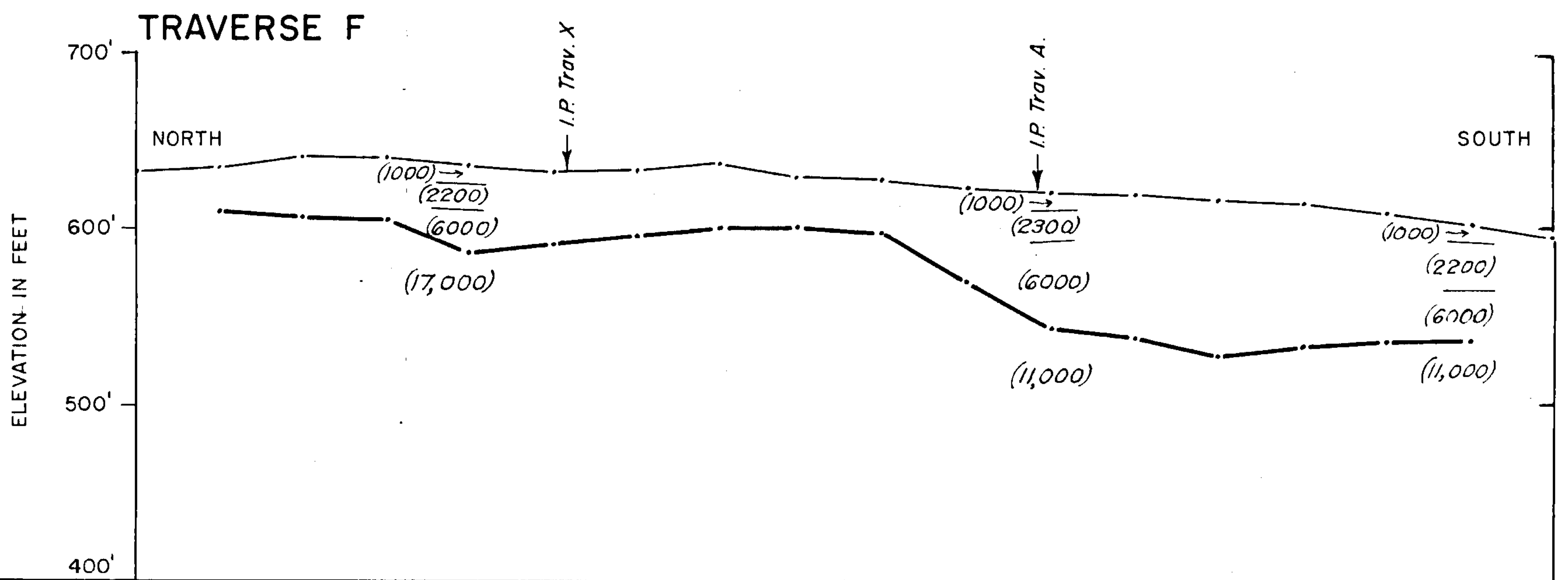
PLATE 13

TRAVERSE G



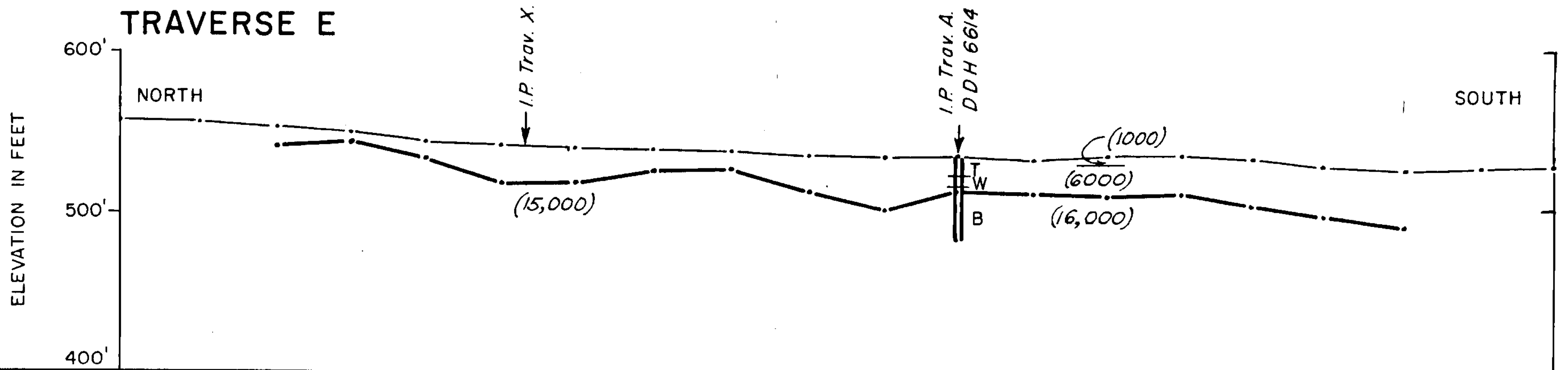
STATION NUMBER	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
STATION ELEVATION	711	716	719	716	716	717	712	705	701	698	695	692	687	684	685	680	670
DEPTH TO BEDROCK	69	74	75	72	51	53	60	51	60	63	72	66	60	54	60	66	

TRAVERSE F



STATION NUMBER		17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
STATION ELEVATION	555	635	641	641	637	639	633	638	632	629	634	629	621	617	616	611	605	600
DEPTH TO BEDROCK		25	32	33	51	45	37	37	32	33	55	81	81	89	81	78	67	

TRAVERSE E



STATION NUMBER	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
STATION ELEVATION	555	551	549	543	541	532	532	540	535	533	535	533	536	537	534	530	527	528	528
DEPTH TO BEDROCK		9	3	9	21	21	16	14	23	34	24	24	24	24	32	32	36		

LEGEND

DDH 6614 — Diamond Drill Hole No. 6614

T — Talus Material

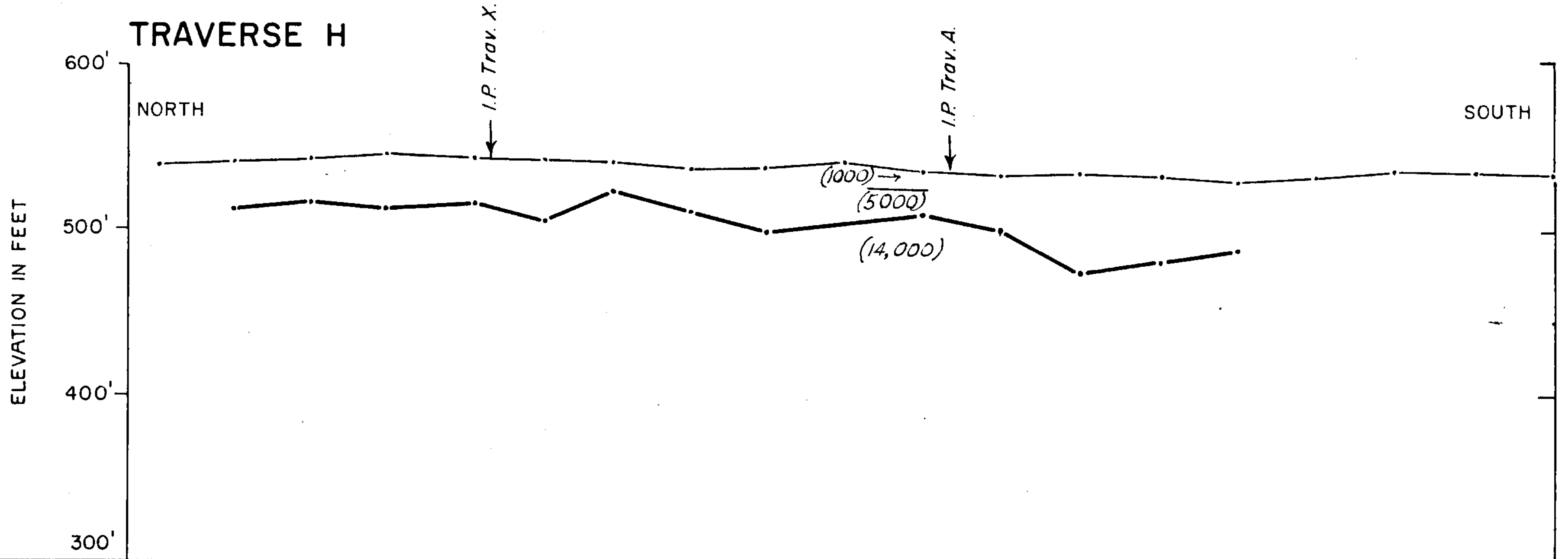
W — Weathered Rock

B — Bedrock

(16,000) — Seismic Velocity in ft/sec

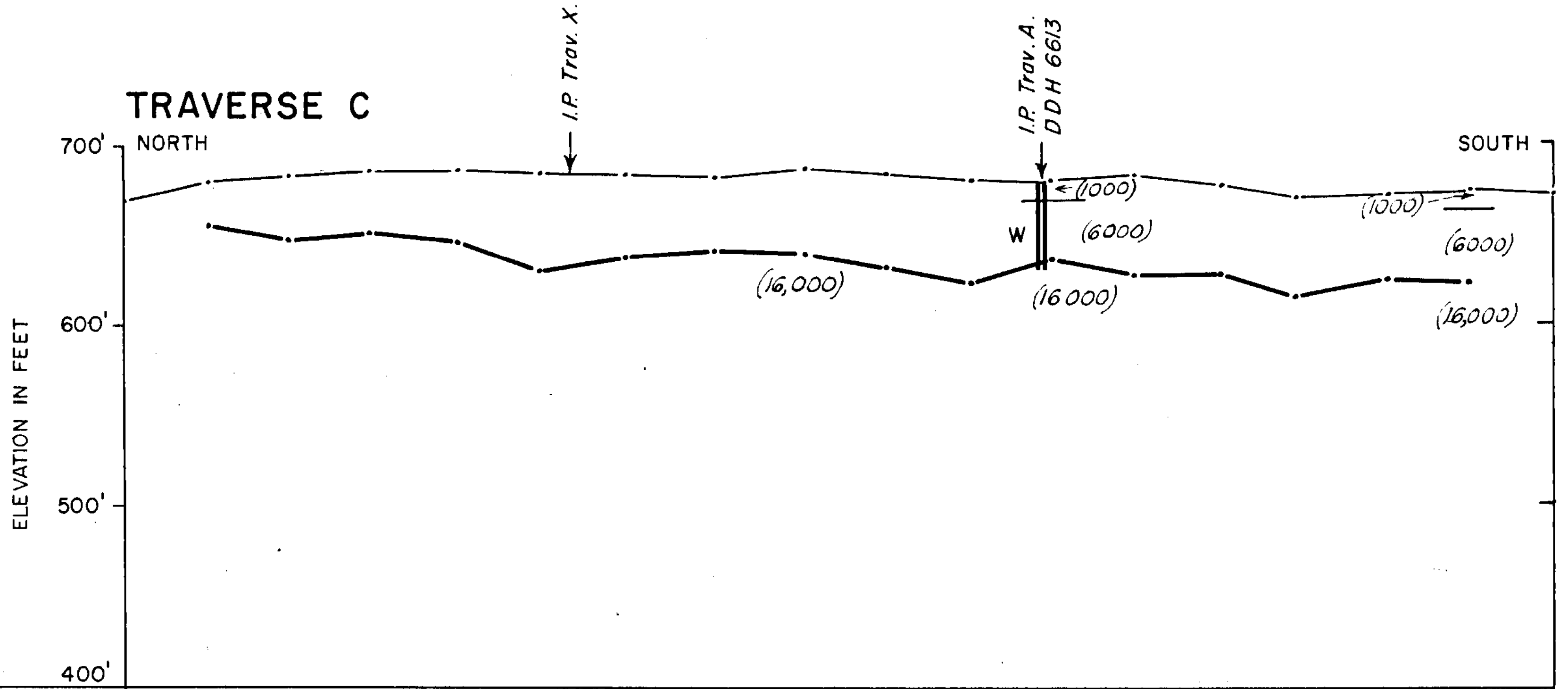
—·—·— Bedrock

TRAVERSE H



STATION NUMBER	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
STATION ELEVATION	538	540	548	545	544	542	540	537	537	540	535	531	532	532	529	531	534	534	532
DEPTH TO BEDROCK		28	27	33	26	36	17	24	39		28	31	60	51	42				

TRAVERSE C



STATION NUMBER	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
STATION ELEVATION	678	682	686	685	683	683	681	685	683	679	680	682	680	671	672	675	675
DEPTH TO BEDROCK	24	36	34	39	53	46	39	43	51	55	42	55	49	51	49	52	

MURCHISON No. 4 DAM SITE

TRAVERSES G,F,E,H and C
CROSS-SECTIONS

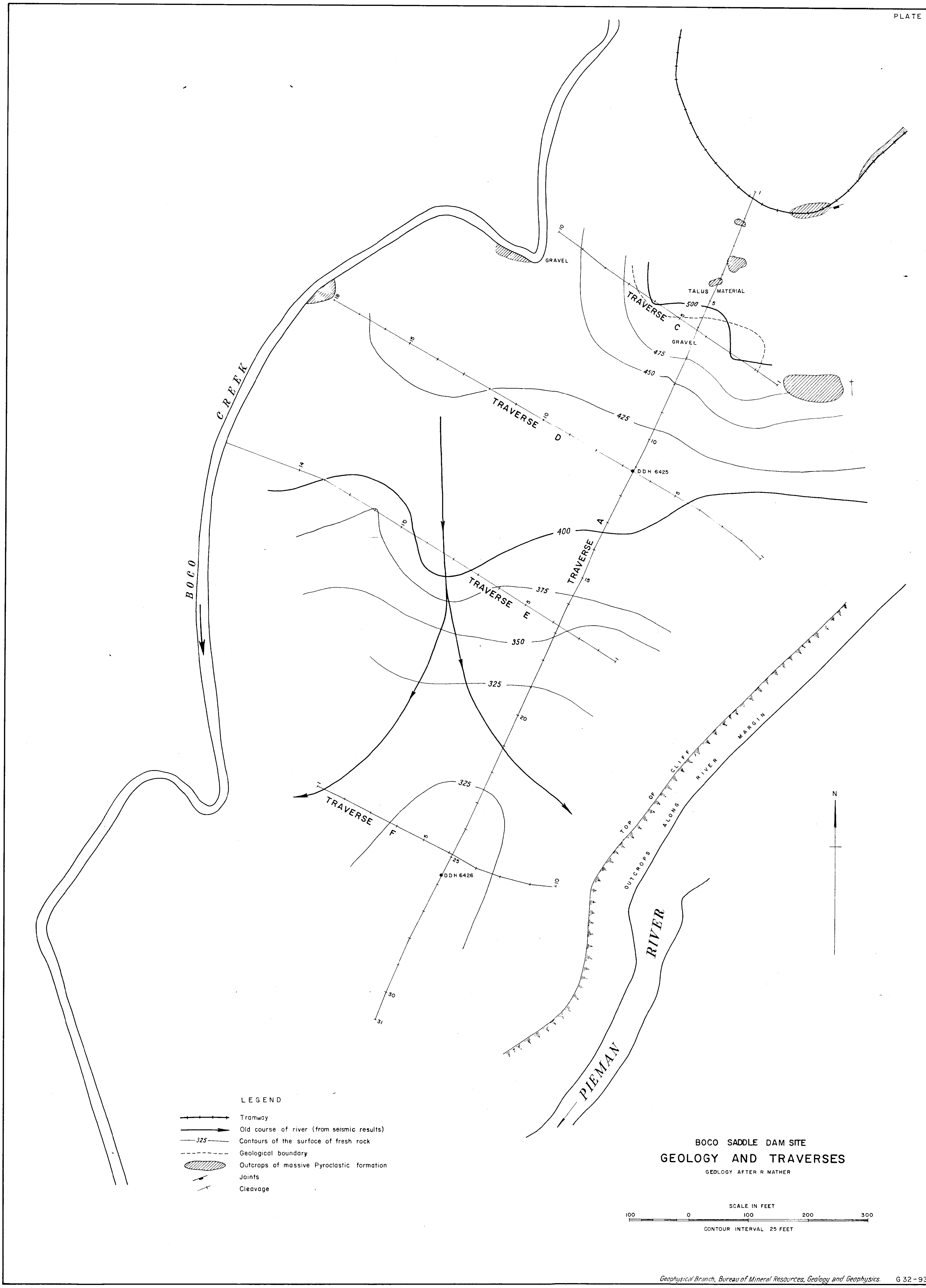
SCALE IN FEET

100 50 0 100 200 300

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics G32-96

To Accompany Record No 1962/68

UPPER PIEMAN... TASMANIA



BOCO SADDLE DAM SITE

GEOLOGY AND TRAVERSES

GEOLOGY AFTER R. MATHER

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. G 32-93

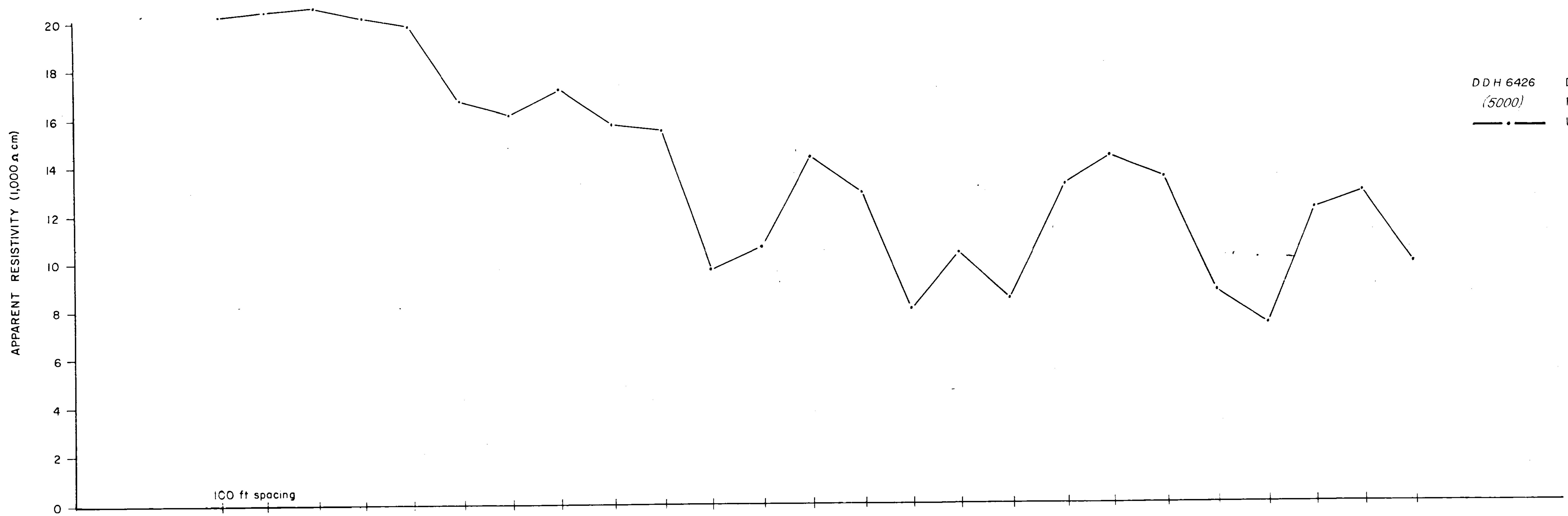
To Accompany Record No. 1962/68

UPPER PIEMAN, TAS. 1960

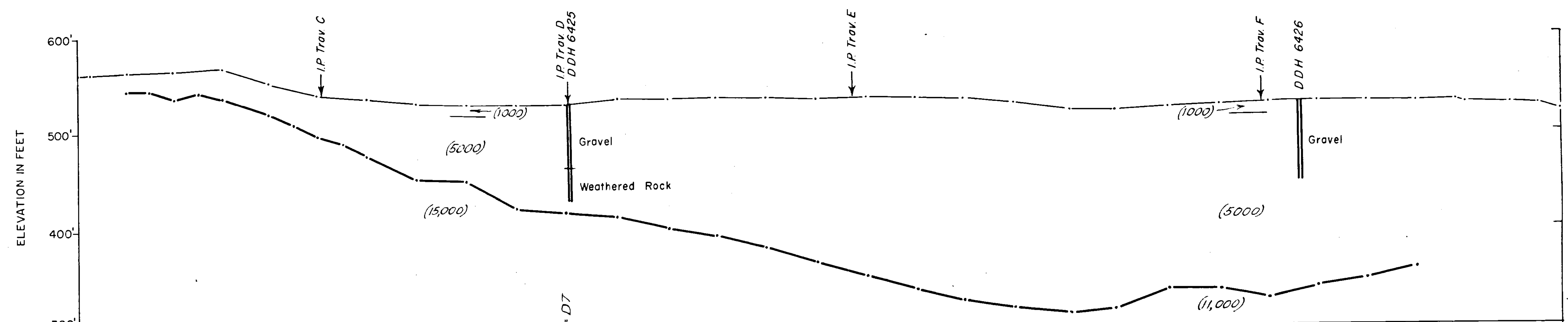
PLATE 15

LEGEND

DDH 6426 — Diamond drill hole
(5000) — Formation with seismic velocity 5000 ft/sec
—·— Unweathered bedrock



TRAVERSE A



STATION NUMBER	STATION ELEVATION	DEPTH TO BEDROCK
1	563	
2	565	18
		19
3	567	28
		25
4	569	31
5	554	32
		36
6	541	43
		48
7	538	60
8	533	80
9	530	80
10	531	108
11	532	113
12	533	123
13	537	133
14	538	143
15	538	155
16	535	170
17	537	185
18	536	200
19	535	210
20	529	213
21	524	213
22	523	207
23	526	190
24	529	193
25	530	205
26	531	193
27	530	185
28	531	173
29	529	
30	526	
31	518	

BOCO SADDLE DAM SITE

TRAVERSE A

PROFILE

AND CROSS-SECTION

SCALE IN FEET

100 50 0 100 200

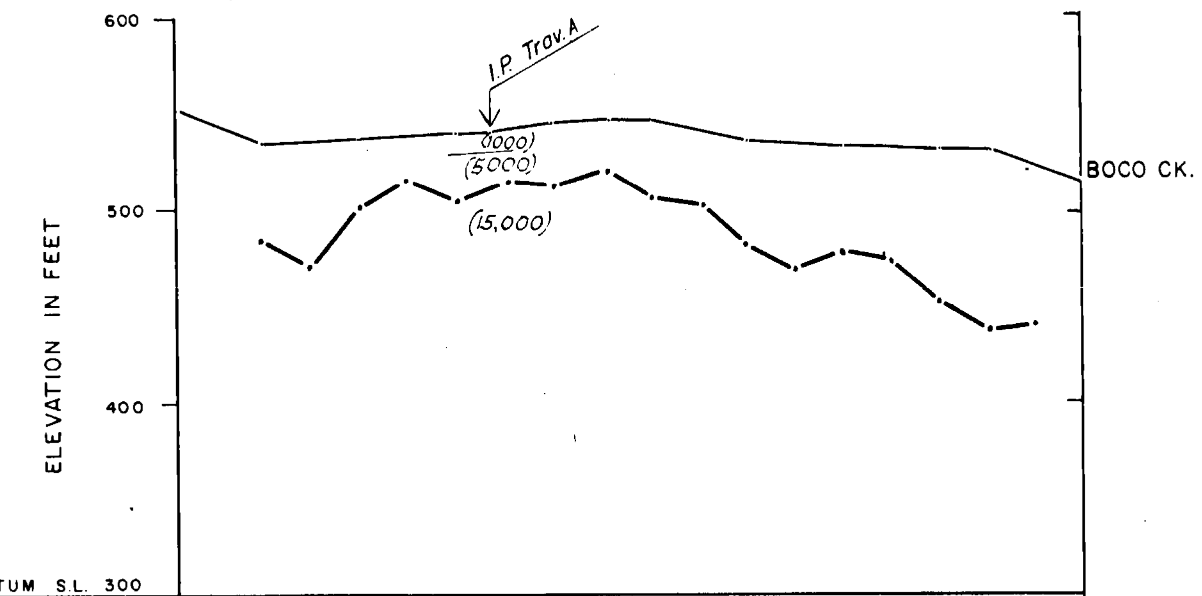
UPPER PIEMAN ~ TASMANIA

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics.

G32-94

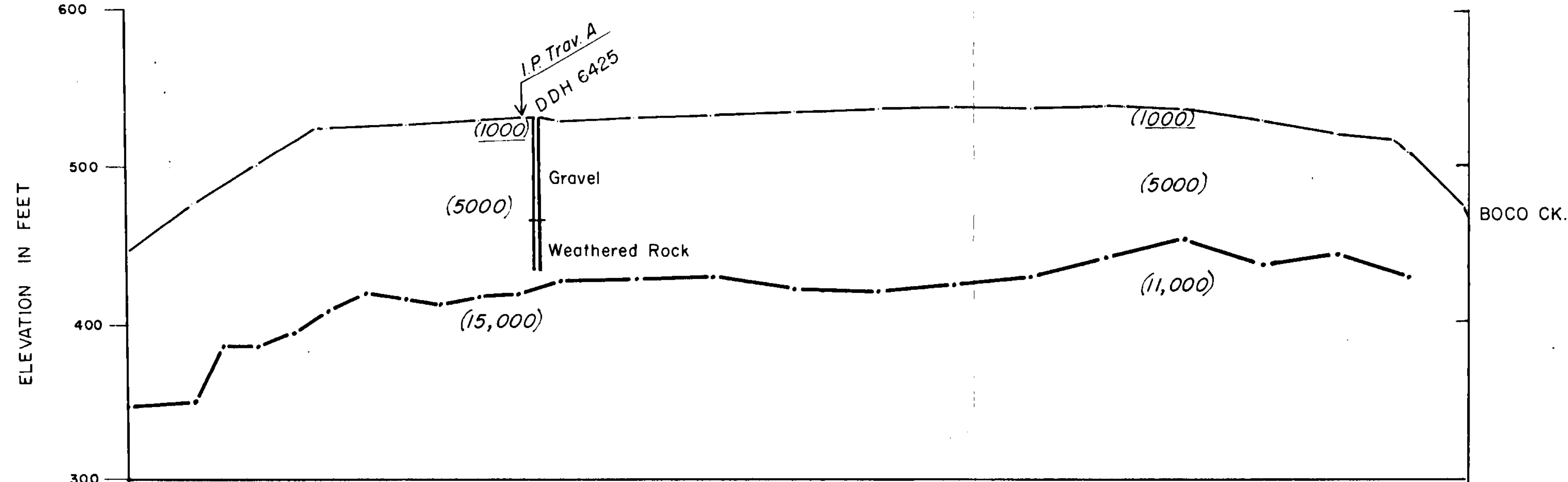
To Accompany Record No. 1962/68

TRAVERSE C



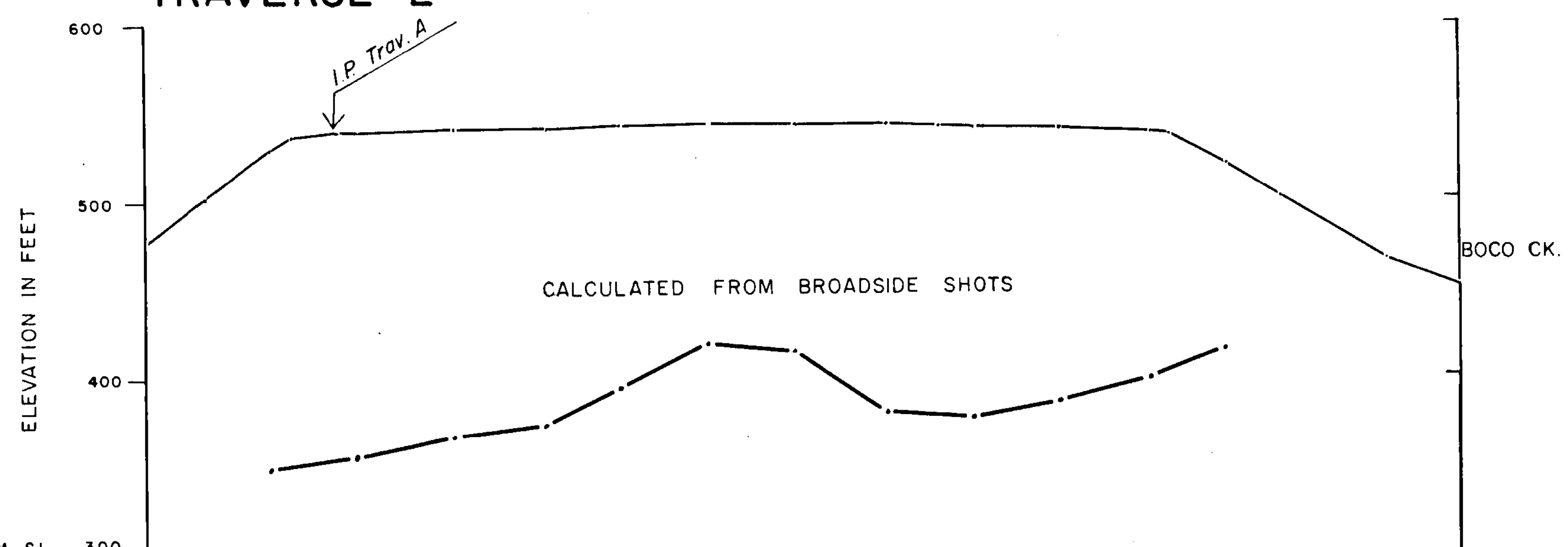
SURFACE LEVEL	552.2, 534.4, 536.3, 540.5, 546.3, 548.5, 546.8, 535.7, 533.7, 532.2, 531.7, 523.7, 515.9
STATION Nº	C1, C2, C3, C4, C5, B204, C6, C7, C8, C9, C10
DEPTH TO BEDROCK	50, 65, 35, 23, 40, 27, 33, 28, 40, 38, 53, 65, 55, 58, 80, 95, 83

TRAVERSE D



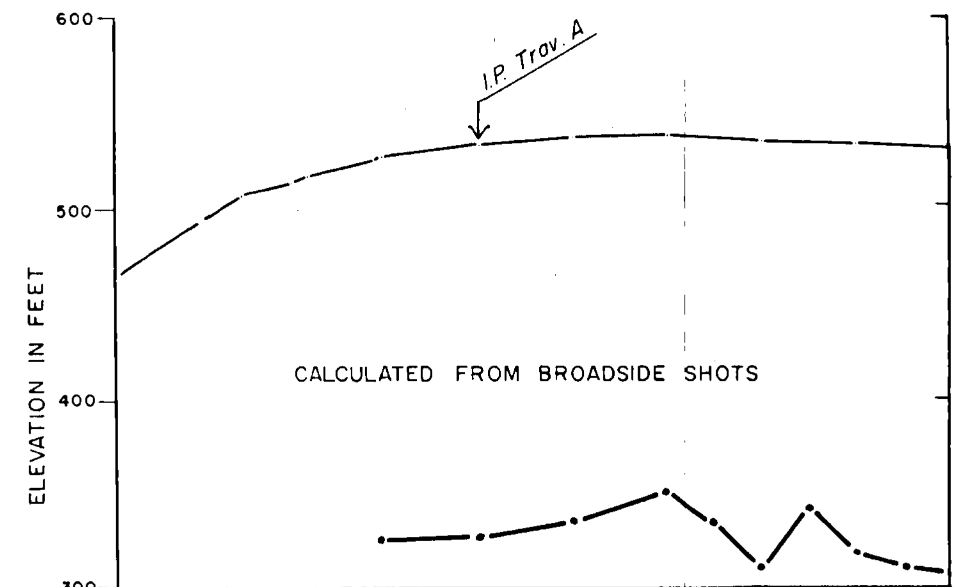
SURFACE LEVEL	445.0, 477.2, 502.4, 526.4, 529.5, 531.5, 531.9, 531.9, 534.6, 536.8, 538.5, 539.5, 539.6, 540.4, 537.3, 530.0, 522.2, 518.0, 511.7, 477.7
STATION Nº	D1, D2, D3, D4, D5, D6, S3, D7, D8, D9, D10, D11, D12, D13, D14, D15, D16, D17, B206, D18
DEPTH TO BEDROCK	98, 128, 103, 118, 123, 118, 108, 113, 118, 113, 113, 103, 105, 105, 115, 118, 115, 110, 98, 83, 93, 78, 83

TRAVERSE E



SURFACE LEVEL	473.1, 500.5, 527.7, 537.5, 538.5, 539.6, 540.3, 541.7, 541.1, 540.3, 539.7, 539.3, 536.3, 518.3, 501.2, 465.2, W.L. 450.7
STATION Nº	E1, E2, E3, E4, E5, E6, E7, E8, E9, E10, E11, E12, E13, E14
DEPTH TO BEDROCK	182, 185, 175, 170, 150, 125, 130, 165, 165, 155, 140, 105

TRAVERSE F



SURFACE LEVEL	463.5, 492.2, 502.8, 508.9, 524.9, 529.9, 532.8, 534.6, 531.7, 530.8, 528.9
STATION Nº	F10, F9, F8, F7, F6, F5, F4, F3, F2, F1
DEPTH TO BEDROCK	200, 205, 202, 187, 200, 223, 192, 215, 220, 223

LEGEND

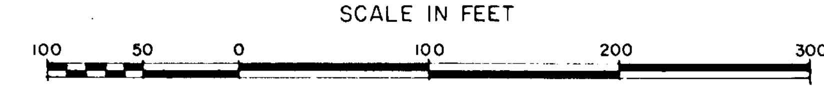
DDH 6425	Diamond drill hole
(5000)	Formation with seismic velocity 5000ft/sec.
— · —	Unweathered bedrock

BOCO SADDLE DAM SITE

TRAVERSES C, D, E and F

CROSS-SECTIONS

SCALE IN FEET



UPPER PIEMAN HYDRO. ELEC. TAS.

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics

G32-85

To Accompany Record No. 1962/68