COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS.

RECORDS

1959 NO. 85.

GEOPHYSICAL INVESTIGATION AT THE ROSEBERY NO. 1 DAMSITE, TASMANIA.

by

D.F. DYSON and B.J. BAMBER.

RECORDS 1959 NO. 85

GEOPHYSICAL INVESTIGATION AT THE ROSEBERY NO. 1 DAMSITE, TASMANIA.

by

D.F. DYSON and B.J. BAMBER

* *

CONTENTS

PLATES

ABSTRACT

Seismic refraction and resistivity investigations were carried out in response to an application from the Hydro-Electric Commission of Tasmania to investigate a proposed dam site on the Pieman River near Rosebery.

At the site overburden, less than 100 feet thick, and consisting of talus, scree, till gravel and weathered rock overlies bedrock which consists of Permian Pyroclastics and lavas. The purposes of the surveys were to determine the depth to bedrock and some of the physical properties of the bedrock and overburden.

Seismic velocities of 1,400 to 8,000 ft/sec. were recorded in the overburden and velocities of 11,000 to 18,000 ft/sec. in the bedrock.

It is estimated that the thickness of the overburden has been calculated, in general, with a maximum error of $\pm$ 20 per cent. There is, however, one region where the estimate of overburden thickness may be 50 per cent in error. On the traverse there are no drillholes which could be used for control of the seismic calculations.

****

1. INTRODUCTION

The Hydro-Electric Commission of Tasmania proposes to construct a dam on the Pieman River about four miles north of the township of Rosebery. The approximate latitude and longitude of the site are 41° 43' S. and 145° 30' E. respectively. The dam will be part of the Pieman River Scheme.

In response to an application from the Commission, the Bureau of Mineral Resources carried out a geophysical survey on the site to determine the depth to bedrock and some of the physical properties of the overburden and bedrock.

The seismic refraction and resistivity methods were applied. The survey was conducted from 27th February to 3rd March 1959, by a party consisting of D.F. Dyson (Party Leader), B. Bamber (Geophysicist) and J. Croger (Geophysical Assistant). The Commission provided an additional five assistants and carried out the topographical survey on the traverse line.

2. GEOLOGY

The geology of the area is described by Ward (1908) and Bradley (1954, 1956). A detailed geological examination of the site was carried out by Mather (1958) and his geological map is reproduced on Plate 1. This is a map of the area at the southern end of the traverse where the geophysical measurements were taken.

Although the topographical relief of 200 feet in the length of 2,200 feet is relatively slight, it was thought possible that the bedrock might be very deep at the northern end of the traverse where there is a topographical gully.

The term "bedrock", as used in this report, refers to Cambrian pyroclastics and lavas, which have a seismic velocity ranging from 11,000 to 18,000 ft/sec. The term "overburden" refers to soil, talus, scree and weathered Cambrian pyroclastics and lavas which overly the bedrock. The seismic velocity in the overburden ranges from 1,400 to 8,000 ft/sec.

3. METHODS

The resistivity and seismic refraction methods were applied.

A. Resistivity Method.

Different rock types possess different electrical resistivity, as a result of variation in the lithology and physical properties of the rocks. Hard, non-porous, unweathered rocks generally have a high resistivity. Shearing and fracturing cause localised weathered zones which, because of the resultant increase in porosity, water content and salinity of the pore solutions, produce a decrease in resistivity. As a general rule it may be said that the resistivity of a rock is inversely proportional to the product of porosity and salinity of the pore solutions.

In the Wenner method of "resistivity traversing", which was used in the present investigations, four electrodes, equally spaced in a straight line are moved as a whole along a traverse and readings are taken at consecutive stations. The electrode spacing is of the same order of magnitude as the depth to which the resistivity is measured. The resistivity value measured is an apparent resistivity and not a true value for any particular rock layer. In the interpretation, absolute values of the apparent resistivity are not as important as sudden changes from high to low apparent resistivity - such changes generally indicate a change in rock type.

The total length of resistivity traverses surveyed was 2,200 ft. They were surveyed twice using 100 foot and 50 foot electrode spacings. A Tellohm Geophysical Meter, manufactured by Nash and Thomson (U.K.) was used.

B. Seismic Method.

The seismic method of exploration depends on the contrast in the velocity of seismic waves through different rock formations. Hard, unweathered rocks have higher velocities than their weathered counterparts, while these in turn usually have higher velocities than soil and unconsolidated deposits.

The method of differences was used (Heiland, 1946) and the following types of spread were shot.

(i) Weathering Spreads. These were used to obtain seismic wave velocities in, and the thickness of, near-surface layers. The geophone intervals were 10 ft. and shot points were 10 ft., 50 ft., and 150 ft. from each end of the spread.

(ii) Normal Spreads. The geophone intervals were 25 ft. and 50 ft. and shot points were 50 ft. and 200 ft. from each end of the spread.

The equipment used in the seismic survey was an SIE 12-channel refraction seismograph Type PRO-11-6 with Technical Instrument Co. geophones of natural frequency about 20 cycles per second. The total length of seismic traverses surveyed was 2,200 ft.

4. RESULTS

A. Resistivity Survey.

The results of the resistivity survey using electrode spacings of 100 and of 50 foot are shown in profile on Plate 2.

The only relatively high values of resistivity correspond to the topographical high between pegs 30 and 36. This may mean that the bedrock in this region is closer to the surface although the same effect could be caused by the better drained and drier overburden which may be expected on such a topographical high.

Provided the thickness of overburden alohg most of the traverse is not more than the electrode spacing, and this is indicated as fact by the seismic work, then the lack of contrast in apparent resistivity values along the traverse suggests that the overburden does hot change very much in thickness or resistivity along the traverse.

B. Seismic Survey.

Plate 2 shows the interpretation of the results of the seismic survey in the form of a profile, indicating the thickness of the overburden.

Table 1 shows a tentative interpretation of velocities in terms of rock type.

TABLE 1.

	Rock type	Seismic velocity (ft/sec)	Estimated Youngs Modulus (lbs. wt/sq.in.)
	Soil	1400 - 1600	
Overburden	Scree and Talus	4200	
	Weathered Cambrian Pyroclastics and Lavas	7500 - 8000	$1.6\text{-}1.8 \times 10^6$
Bedrock	Unweathered Cambrian Pyroclastics and Lavas	11000 - 18000	3.3×10^6 to 11.6×10^6

The depth to bedrock between Pegs 30 and 36 could perhaps be greater than is indicated. This possible lower boundary is shown on Plate 2 by a dotted line. The lower boundary indicates what is considered to be the maximum possible value of the depth to bedrock in this region.

In general the work indicates that there is no deep gully in the bedrock along the traverse line.

To estimate the Young's Modulus values shown in Table 1, a density value of 2.7 (c.g.s. units) was taken as an average for the Cambrian pyroclastics and lavas and a Poisson's ratio of 0.3 for rock of 7,500 to 11,000 ft/sec. velocity and 0.1 for rock of 18,000 ft/sec. velocity (Birch, Schairer and Spicer, 1950).

Although the thickness of overburden between pegs 30 and 36 may be as much as 50% in error, elsewhere, it is considered the maximum error is not in excess of 20%. Along the traverse there is no drill hole which could be used as control data for improving the accuracy of the seismic calculations.

5. CONCLUSIONS

The geophysical survey provided information on the depth to bedrock at the dam site. The overburden consists of soil, scree, talus and weathered bedrock. The bedrock consists of Cambrian pyroclastics and lavas.

The seismic survey indicated that the overburden is fairly uniform along the traverse but is thickest between pegs 30 and 36. In this region it reaches the depth of 66 feet. The general uniformity of the overburden thickness is supported by the resistivity measurements.

6. REFERENCES

Birch, F., Schairer, J.E. and Spicer, H.B. - 1950 - Handbook of Physical Constants - U.S.A. Geol. Soc. Spec. Paper 36

Bradley, J., - 1954 - The Geology of the West Coast Range of Tasmania, Pt. 1. Papers 8 - Proc. Roy. Soc.Tas. 88.

Bradley, J., - 1956 - Idem, Pt. 11, Ibid., 90

Heiland, C.A., - 1946 - Geophysical Prospecting Prentice-Hall Inc., New York.

Mather, R.P., - 1958 - The Geological Map of the Rosebery No. 1 Dam Site (Unpublished).

Ward, L.K., - 1958 - The Mount Farrell Mining Field. Tas. Dept. Mines Geol. Surv. Bull. 3.

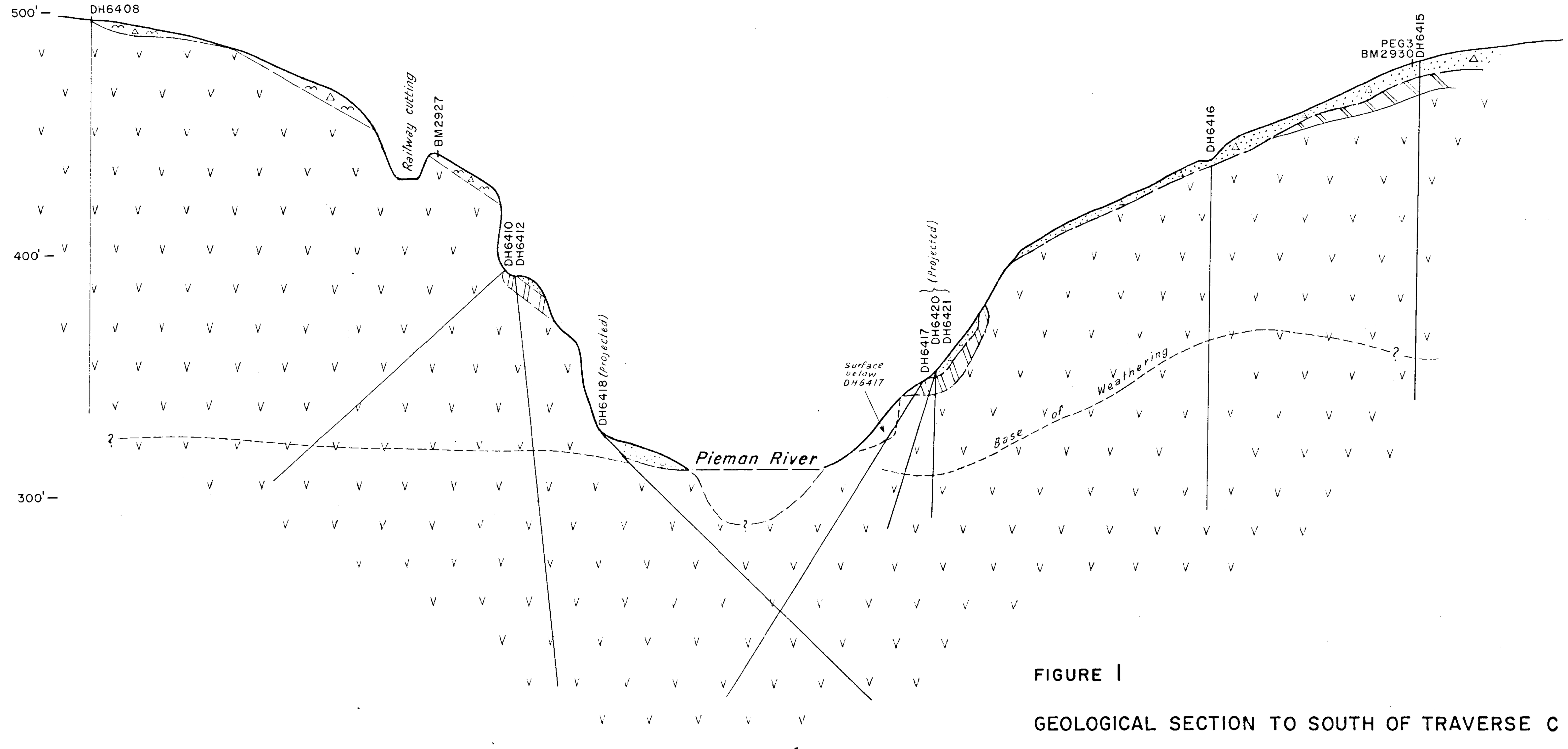
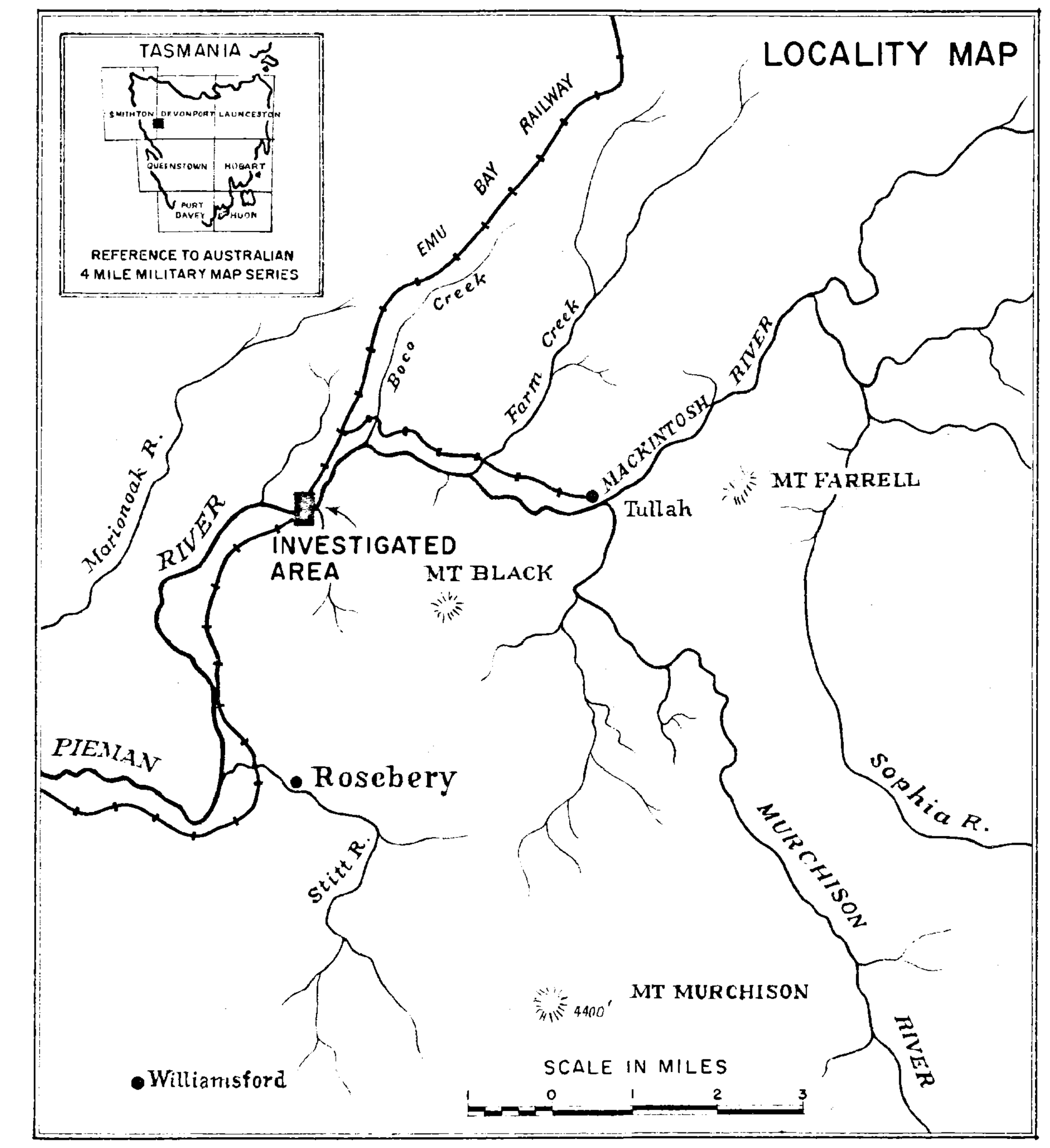


FIGURE 1

GEOLOGICAL SECTION TO SOUTH OF TRAVERSE C



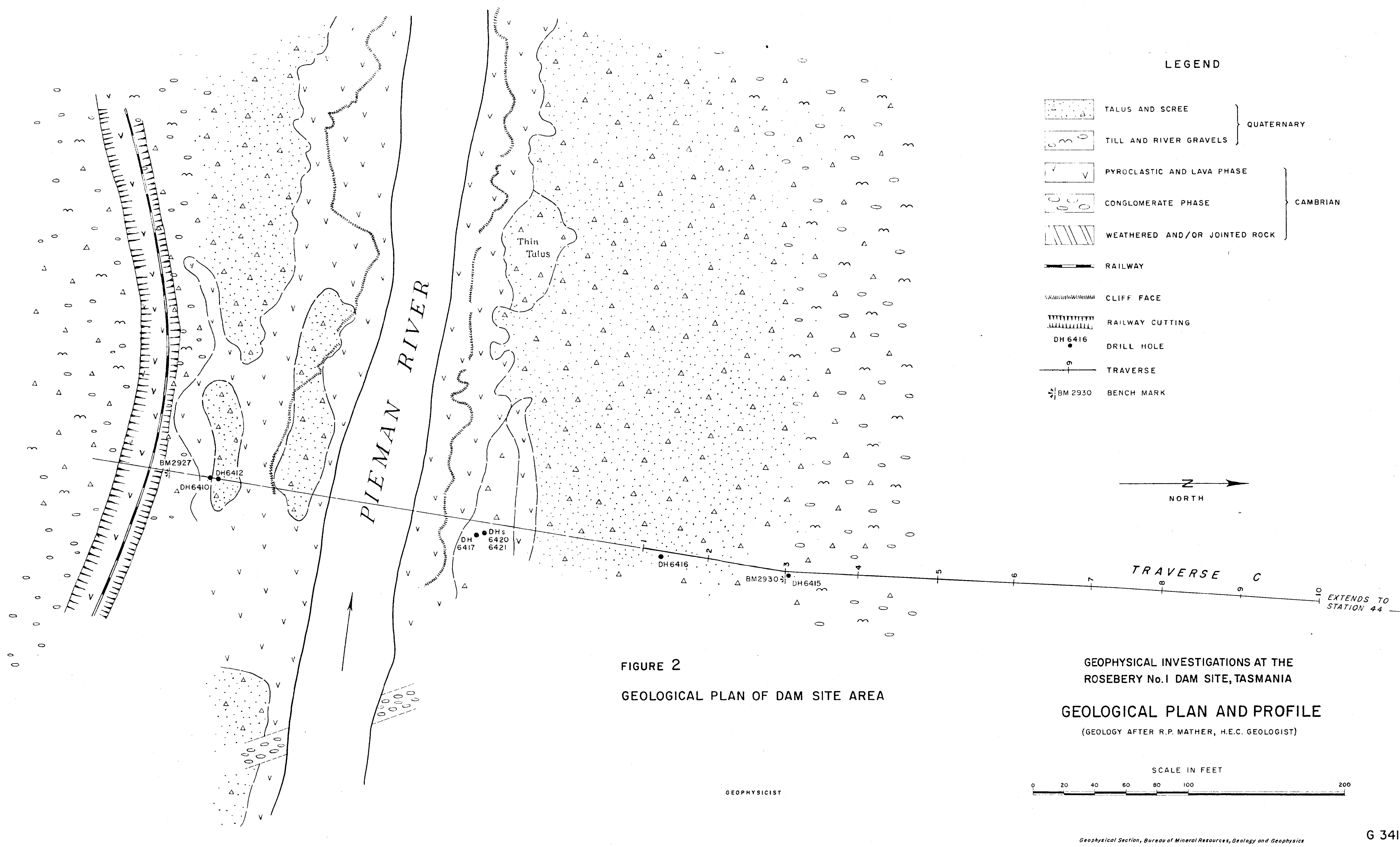


FIGURE 2

GEOLOGICAL PLAN OF DAM SITE AREA

GEOPHYSICAL INVESTIGATIONS AT THE ROSEBERY No. I DAM SITE, TASMANIA

GEOLOGICAL PLAN AND PROFILE

(GEOLOGY AFTER R.P. MATHER, H.E.C. GEOLOGIST)

SCALE IN FEET

0 20 40 60 80 100 200

GEOPHYSICIST

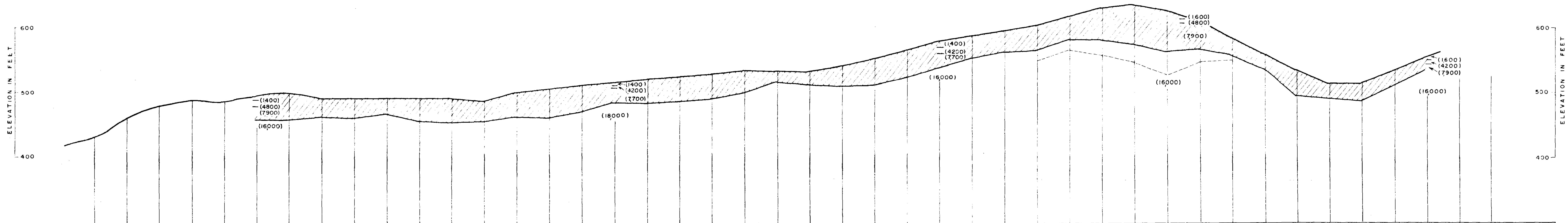
Geophysical Section, Bureau of Mineral Resources, Geology and Geophysics

G 341-1

TO ACCOMPANY RECORDS 1959, No 85

PLATE 2

INTERPRETATION OF SEISMIC TRAVERSE C



STATION NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
SURFACE LEVEL	431	462	480	489	489	495	501	495	494	496	496	496	490	502	509	512	517	522	525	531	535	536
DEPTH TO BEDROCK						33	39	29	29	24	36	39	31	35	44	40	30	36	35	40	33	17

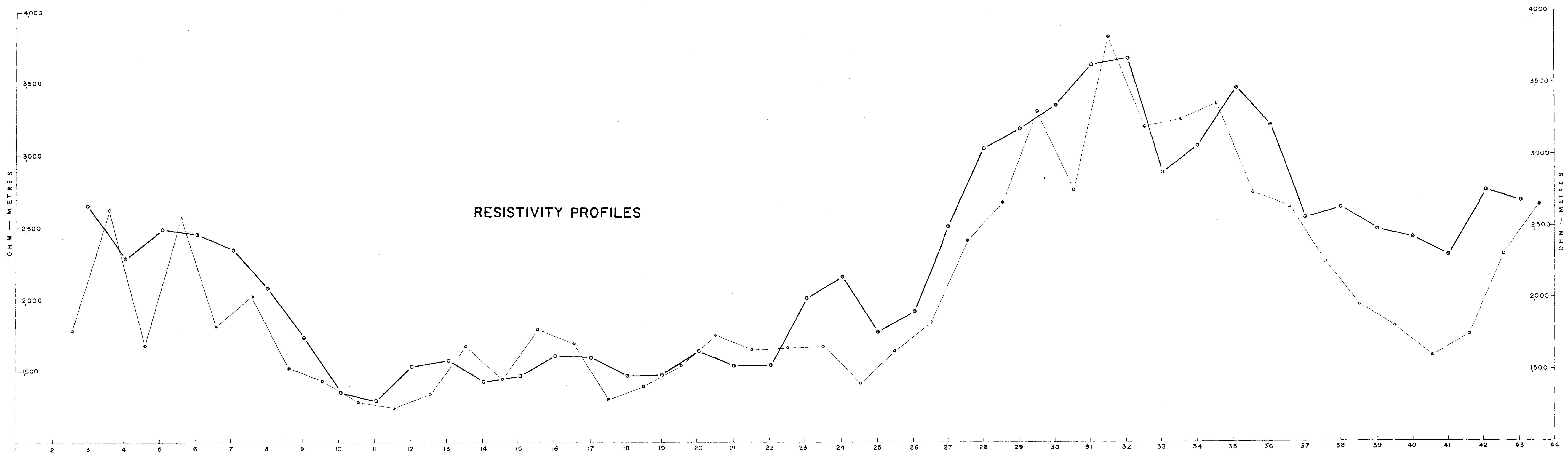
STATION NUMBER	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
SURFACE LEVEL	532	542	554	566	581	589	597	606	620	633	638	630	615	588	561	537	515	515	534	554	572	589
DEPTH TO BEDROCK	18	30	39	39	41	34	32	40	36	50	60	66	45	27	22	40(?)	?	27	23	19		

LEGEND

OVERBURDEN — (16,000) SEISMIC VELOCITY

BEDROCK — ------ POSSIBLE DEEPER BOUNDARY OF BEDROCK

RESISTIVITY PROFILES



LEGEND

—o— RESISTIVITY READINGS USING 100' SPACING

—·— RESISTIVITY READINGS USING 50' SPACING

HORIZONTAL SCALE IN FEET

0 100 200 300 400

GEOPHYSICIST

GEOPHYSICAL INVESTIGATIONS AT THE ROSEBERY No.1 DAM SITE, TASMANIA

SEISMIC AND RESISTIVITY PROFILES

TRAVERSE C

Geophysical Section, Bureau of Mineral Resources, Geology and Geophysics

G 341-2