COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS.

RECORDS

RECORDS 1959 No. 148

MACKINTOSH RIVER DAM SITE
GEOPHYSICAL SURVEY TASMANIA 1959

by

D.F. Dyson and B.J. Bamber

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ABSTRACT.

This Record describes a geophysical survey to measure the depth of overburden at a proposed dam site on the Mackintosh River near Tullah, Tasmania. The work was an extension of the 1957 survey. Seismic Refraction, and Resistivity methods were used.

Although the seismic results cannot distinguish between weathered bedrock and un-weathered bedrock, agreement with bore-hole records is fairly good; the seismic depth measurements are mostly from 10 to 30 per cent greater than actual depths shown by drilling.

Resistivity results confirm (qualitatively) the depth pattern shown by seismic results on the N-W. bank; on the S-E. bank the resistivity contour map is dominated by a feature (S-S' on Plate 2) which is interpreted as a shear zone.

1. INTRODUCTION.

The Hydro-Electric Commission of Tasmania proposes to construct a dam on the Mackintosh River about 4 miles above its junction, near the township of Tullah, with the Murchison River. Army grid reference of the site is 36,700 yds. W., 86,500 yds. N. on the Devonport 4-mile military series. The dam will be part of the Pieman River Scheme. This site was chosen by the Commission from aerial maps; it is near the northern spur of Mt. Farrell.

In 1957 the Bureau of Mineral Resources, in response to an application from the Commission, carried out a geophysical survey of the site to determine the nature of the overburden and bedrock, and depth to bedrock. The results of the original survey have been reported by Polak (1957) and, coupled with the results of a subsequent drilling programme on the dam site, were sufficiently encouraging to lead the Commission to apply for additional geophysical investigations; these investigations are described in this Record.

The Bureau party included D.F. Dyson (Party Leader) B.J. Bamber (Geophysicist) and J. Croger (Geophysical Assistant). The Commission also provided five assistants and carried out the topographical surveying of the traverses. The field work took place during May 1959.

2. GEOLOGY.

The geology of the site has been summarised by Polak (1957), and Plate 6, which is a geological plan of the area, is copied from Polak's report.

Many outcrops of the Dundas Group marked on this plan have subsequently been proved to be only "floaters" of bedrock.

The South-eastern abutment of the dam will rest on a steep bank in the Dundas Group formations; these are of Cambrian age and consist of slate, chert, shale, schist and greywacke. The Owen Conglomerate is of Cambro-Ordovician age (Opik, 1951). The western boundary of the Owen Conglomerate is just outside the area covered by the traverses, except on Traverses B (1959) and C (1959); stations 1 and 2 of these traverses may be on Owen Conglomerate.

3. METHODS.

The seismic refraction and resistivity methods have been described by Polak (1957) in the report on the initial survey of this dam site. The deepest seismic refractor on a traverse is termed "bedrock". The term "overburden" may include soil, scree, river gravel, river terrace material, and weathered bedrock, all of which overlie the unweathered bedrock.

To discriminate between the traverses of the years 1957 and 1959, the year is shown in brackets after the traverse number.

4. RESULTS.

Resistivity Survey.

The electrodes were spaced 100 ft. apart throughout the survey. Resistivity profiles along the traverses are shown on Plates 3 and 4; contours drawn from these profiles are shown on Plate 2.

The most important feature of the contour map is a "valley" of low resistivity whose axis lies on the line S-S' joining points A10,B9 and C8 on the 1959 traverses. The low resistivities here suggest that it is a shear zone, in which weathering has lowered the electrical resistivity of the bedrock and increased the depth of overburden.

Seismic Refraction Survey.

Plates 3 and 4 show cross-sections along the traverses, derived from the seismic results. From these cross-sections an isopach map has been drawn (plate 5) showing contours of equal depth of overburden.

The main features of the Seismic refraction work as indicated by Plate 5 are:-

(a) On the north-west bank the overburden thickness decreases from Traverse A (1959) to Traverse C (1959). In this same area the increasing resistivities from Traverse A (1959) to Traverse C (1959) shown on Plate 2 also suggest a thinning of the overburden; apparent resistivity usually rises as the overburden becomes thinner. On this bank the overburden is shown to be thickest (more than 90 ft.) between A22 and A23.

(b) On the south-east bank the direction of increasing overburden thickness is reversed. Along most of Traverse A (1959) it is less than 40 ft. thick, but along Traverse C (1959) it is seldom less than 60 ft. thick. Traverse B (1959) falls between these extremes. The greatest thickness of overburden is 100 ft., near station C12.

Table 1 shows a tentative interpretation, based on bore-hole records, of velocities in terms of rock type.

TABLE 1.

Rock Type		Seismic Velocity (ft/sec) (V)	Young's Modulus (lb/sq.in.) (E)	Young's Modulus (dyn /sq.cm.)
Overburden	Soil	800-2000		
	Scree, River Gravel, Terrace material	2000-6000		
	Weathered Dundas Group rocks	7000-12,000	$1.3\text{-}3.8 \times 10^{6}$	$9.0\text{-}26.2 \times 10^{10}$
Bedrock	Unweathered Dundas -Group Rocks	10,000-18,000	$2.5\text{-}11.6 \times 10^{6}$	$17.2\text{-}83.0 \times 10^{10}$

TABLE 2

(facing page 3)

Bore-hole Number	Bore-Hole Data		Results of 1957	Results of Present Survey (1959)
	Depth to Bedrock.	Depth to Weathered Bedrock.	Depth to Bedrock (in direction of bore-hole).	Depth to Bedrock (in direction of bore-hole).
6514	115'	21'	11-26' (8000 ft/sec layer)	26' (10,500 ft/sec layer)
6518	130'	55'	52'	70'
6501	25'	5'	24' (11,000-14,000 ft/sec layer)	30' (11,000 ft/sec layer)
6504	100'	15'	est. 50'	100'
6503	130'	80'	65' (15,000-18,000 ft/sec layer)	80' (14,500 ft/sec layer)
6520	110'	55'	25' (12,000-16,000 ft/sec layer)	90'
6515	52'	8'	28' (12,000 ft/sec layer)	50' (15,000 ft/sec layer)
6510	(?)10'	5'	19' (13,500-15,000 ft/sec layer)	46' (17,000 ft/sec layer)
6519	75'	22'	17' (13,500-15,000 ft/sec layer)	83' (17,000 ft/sec layer)

The values of Young's Modulus (E) were obtained from an empirical formula $E = V^{2,34} \times 10^{-3}$ lb/sq.in. partly based on data published by Birch, Schairer and Spicer (1950). V is the seismic longitudinal velocity in ft/sec. The maximum possible error in Young's Modulus is less than 30 per cent.

In Table 2 results of the 1957 and 1959 surveys are compared with the bore-hole information now available, supplied by the Commission.

Alongside each depth measurement is shown the seismic velocity in the layer which was taken to be bedrock in each survey. For drill holes 6518, 6504 and 6520, the velocity in the deepest seismic refractor cannot be specified in column 4 as these holes are too far from any traverse.

From Table 2 it appears that the calculated depth to bedrock, found from the seismic results of the present survey, corresponds sometimes with the actual depth to bedrock and sometimes with the depth to weathered bedrock. This is understandable, as the ranges of the velocities in bedrock and weathered bedrock overlap. The results indicate that the seismic depth measurements are generally between 10 and 30 per cent greater than the true depths shown by drilling.

5. CONCLUSIONS.

The geophysical survey provided information on the depth to bedrock at the proposed dam site. The overburden consists of soil, scree, gravel, river terrace material and weathered bedrock. The bedrock consists of rocks of the Dundas Group.

The seismic survey showed that on the south-east bank the depth of overburden increases from Traverse A (1959) to Traverse C (1959), but on the north-west bank the depth of overburden increases from Traverse C (1959) to Traverse A (1959).

The overburden thickness, which ranges from 20 to 105 ft. with an average value of about 50 ft., reaches its maximum value near station C12.

The resistivity work served to verify qualitatively the seismic work on the north-west bank.

6. REFERENCES.

BIRCH, F., SCHAIRER, J.E., and SPICER, H.B., 1950 - Handbook of Physical Constants. U.S.A. Geol. Soc. Spec. Paper 36.

OPIK, A.A., 1951 - Notes on the Stratigraphy and Palaeontology of Cambrian, Ordovician and Silurian Rock in Tasmania. Bur. Min. Resourc. Aust. Records 1951/5.

POLAK, E.J., 1957 - Geophysical Investigation at the Mackintosh River Dam Site, Tasmania. Bur.Min.Resour.Aust. Records 1957/60.

PLATE I

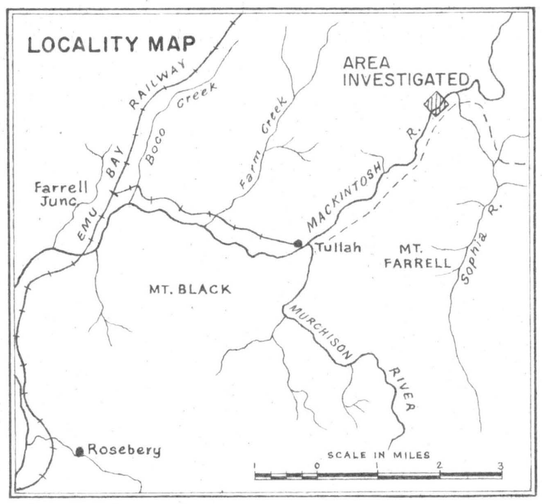
TRAVERSE D (1957)
TRAVERSE E (1957)
TRAVERSE F (1957)
TRAVERSE H (1957)
TRAVERSE A (1957)
TRAVERSE B (1957)
TRAVERSE C (1957)
TRAVERSE H (1959)
TRAVERSE G (1959)
TRAVERSE F (1959)
TRAVERSE E (1959)
TRAVERSE D (1959)
TRAVERSE B (1959)
TRAVERSE A (1959)
TRAVERSE C (1959)

DH6519
DH6503
DH6510
DH6505
DH6507
DHs6509 6511
DHs6504 6506
DH6501
DHs6502 6518
DH 6508
DH6515
DHs6514 6521
BM2864
DH6520

MACKINTOSH RIVER

Approx. North

LOCALITY MAP



LEGEND

- TRAVERSE
- DH 6516 DRILL HOLE
- BM 2864 BENCH MARK
- CONTOUR (Feet)

SCALE IN FEET
100 50 0 100 200 300

GEOPHYSICAL INVESTIGATIONS, MACKINTOSH RIVER DAM SITE, TASMANIA, 1957 AND 1959

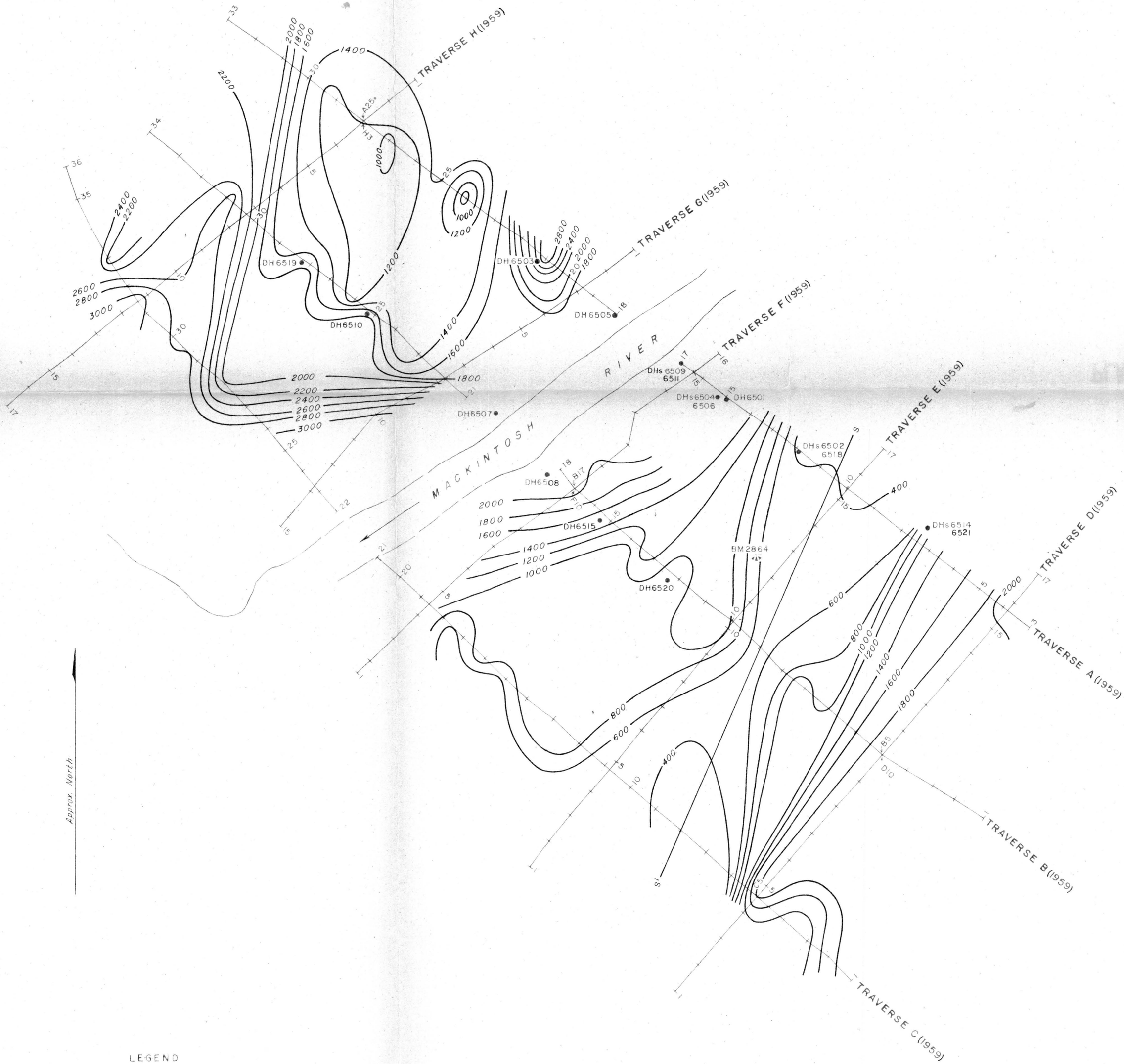
TOPOGRAPHY AND GEOPHYSICAL TRAVERSES

(AFTER H.E.C. PLAN A4283)

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

G 279 – 8

PLATE 2



LEGEND

15 —	TRAVERSE
● DH6516	DRILL HOLE
BM2864	BENCH MARK
1200	CONTOUR (OHM-METERS)
S' — S	CENTRE OF REGION HAVING LOW VALUES OF APPARENT RESISTIVITY.

SCALE IN FEET

100 50 0 100 200 300

GEOPHYSICAL INVESTIGATIONS,
MACKINTOSH RIVER DAM SITE,
TASMANIA, 1959

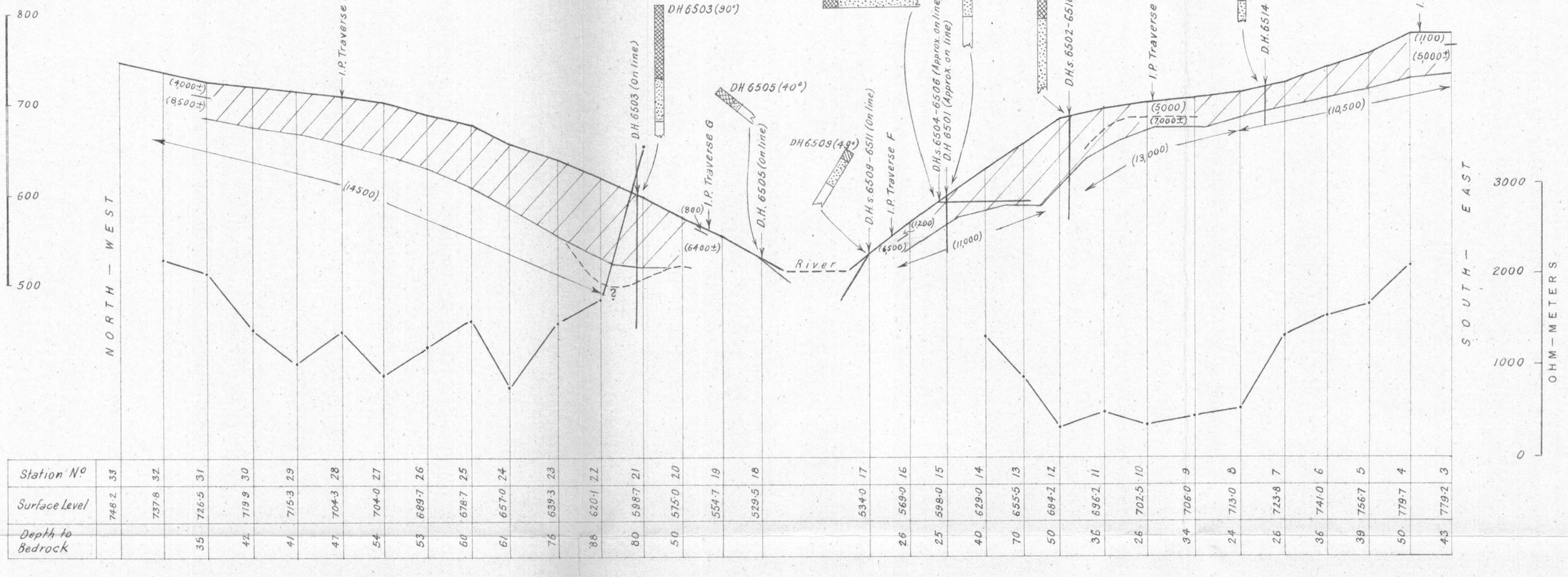
APPARENT RESISTIVITY CONTOURS
(ELECTRODE SPACING 100 FEET)

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. G 279-10

To accompany Records 1959/148

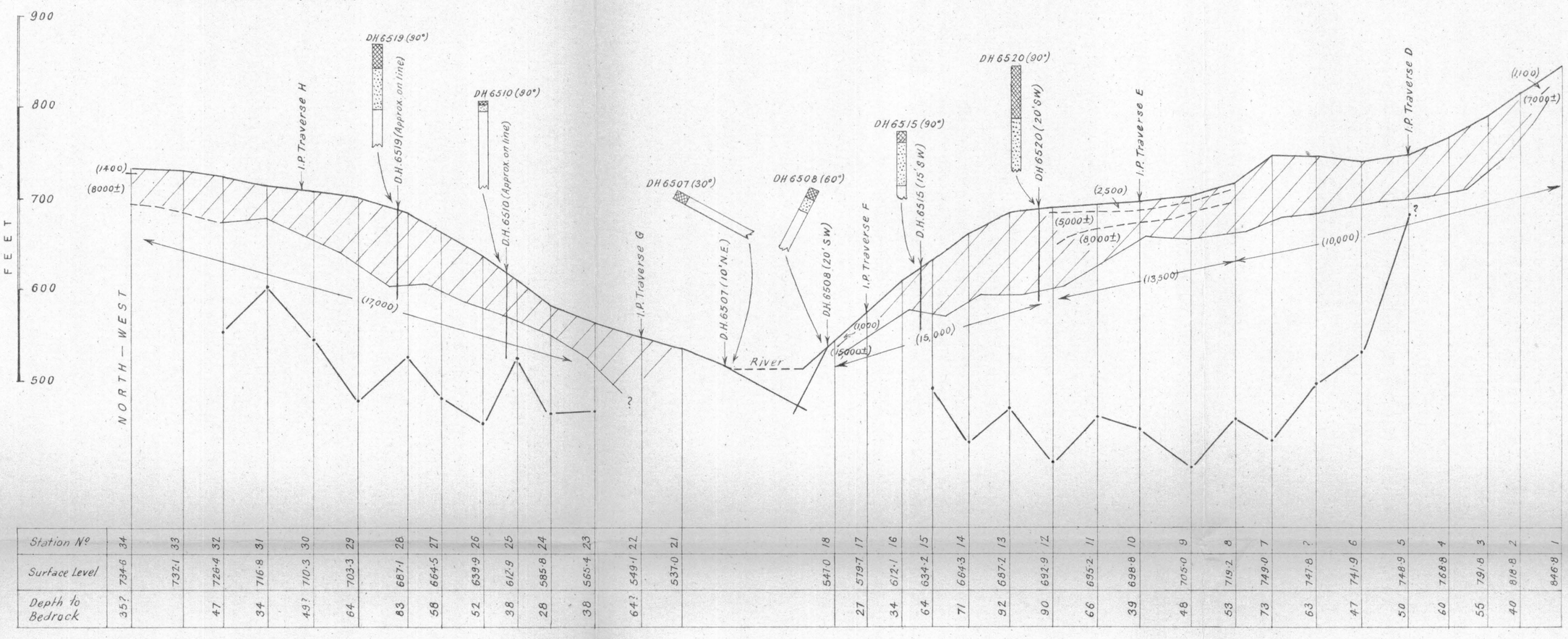
PLATE 3

TRAVERSE A (1959)



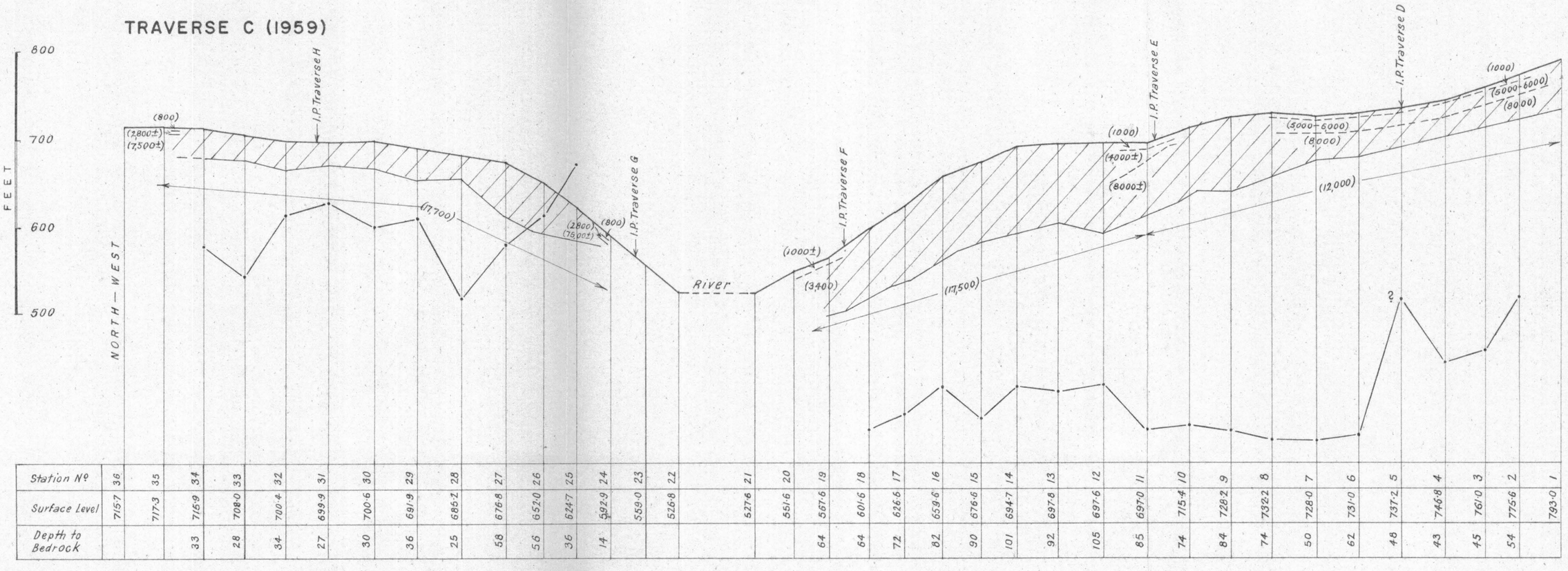
Station No°	33		32		31		30		29		28		27		26		25		24		23		22		21		20		19		18		17		16		15		14		13		12		11		10		9		8		7		6		5		4		3
Surface Level	748·2		737·8		726·5		719·9		715·3		704·3		704·0		689·7		678·7		657·0		639·3		620·1		598·7		575·0		554·7		529·5		534·0		569·0		598·0		629·0		655·5		684·2		696·2		702·5		706·0		713·0		723·8		741·0		756·7		779·7		779·2	
Depth to Bedrock				35		42		41		47		54		53		60		61		76		88		80		50		80		26		25		40		70		50		36		26		34		24		26		36		39		50		43	

TRAVERSE B (1959)



Station No°	34		33		32		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
Surface Level	734·6		732·1		726·4		716·8		710·3		703·3		687·1		664·5		639·9		612·9		585·8		565·4		549·1		537·0		547·0		579·7		612·1		634·2		664·3		687·2		692·9		695·2		698·8		705·0		719·2		749·0		747·8		741·9		748·9		768·8		791·8		818·8		846·8	
Depth to Bedrock	35?			47		34		49?		64		83		58		52		38		28		38		64?						27		34		64		71		92		90		66		39		48		53		73		63		47		50		60		55		40		

TRAVERSE C (1959)



Station No°	36		35		34		33		32		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
Surface Level	715·7		717·3		715·9		708·0		700·4		699·9		700·6		691·9		685·2		676·8		652·0		624·7		592·9		559·0		526·8		527·6		551·6		567·6		601·6		626·6		659·6		676·6		694·7		697·8		697·6		697·0		715·4		728·2		732·2		728·0		731·0		737·2		746·8		761·0		775·6		793·0	
Depth to Bedrock				33		28		34		27		30		36		25		58		56		36		14						64		64		72		82		90		101		92		105		85		74		84		74		50		62		48		43		45		54		

LEGEND

- OVERBURDEN
- BEDROCK
- (2,800) SEISMIC VELOCITY IN FT/SEC.
- (7,500±) SEISMIC VELOCITY IN FT/SEC. IN WHICH THE POSSIBLE ERROR OF DETERMINATION IS CONSIDERED GREATER THAN 10%
- I.P. INTERSECTION POINT
- DH 6503 DRILL HOLE
- DH 6502 (60°) DRILL LOG SHOWING INCLINATION TO HORIZONTAL
- TALUS, SCREE, GRAVEL ETC.
- WEATHERED BEDROCK
- BEDROCK

HORIZONTAL SCALE IN FEET

100 0 100 200 300

VERTICAL SCALE AS SHOWN

GEOPHYSICAL INVESTIGATIONS, MACKINTOSH RIVER DAM SITE, TASMANIA, 1959

INTERPRETATION OF SEISMIC SURVEY, AND RESISTIVITY PROFILES (100 FT. SPACING)

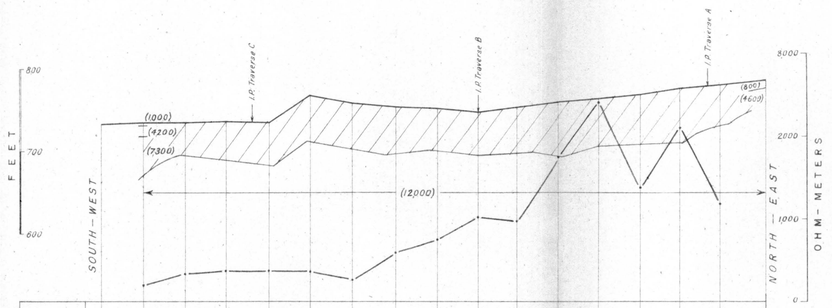
TRAVERSES A, B and C (1959)

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics

G 279-5

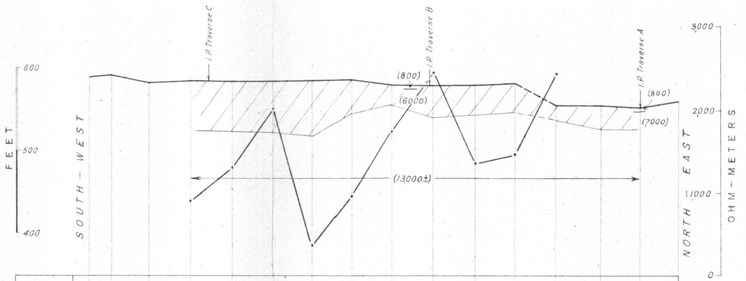
TO ACCOMPANY RECORDS, 1959 No 148

TRAVERSE D (1959)



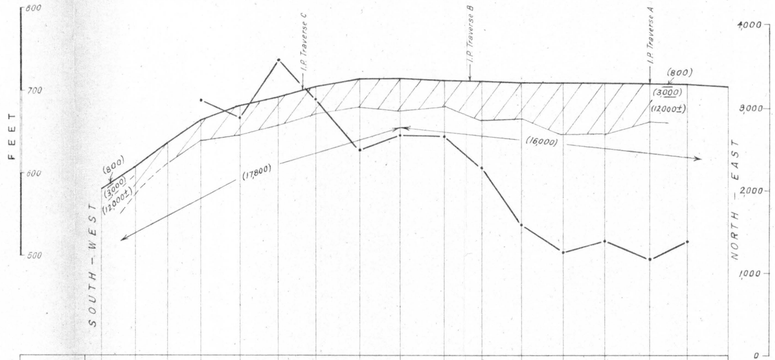
Station No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Surface Level	731.6	736.0	736.4	737.4	736.8	736.6	736.6	734.6	732.8	746.9	726.0	760.8	765.8	770.6	778.4	782.6	768.0
Depth to Bedrock			41	49	66	65	56	61	53	54	60	71	60	62	65	46	

TRAVERSE F (1959)



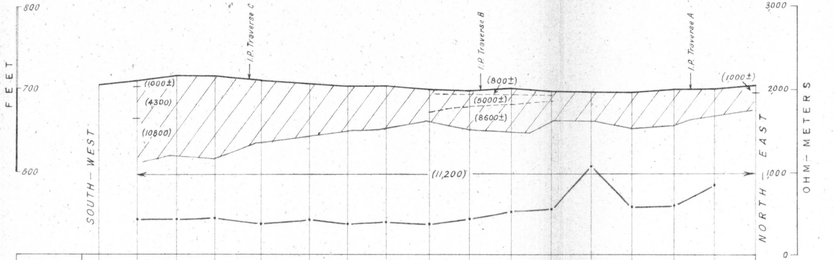
Station No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Surface Level	598.6	596.6	583.2	585.6	584.2	584.8	586.1	586.6	580.0	579.7	580.1	582.0	555.8	564.8	582.2	580.8
Depth to Bedrock				57	55	59	65	39	22	39	35	35	17	25		

TRAVERSE H (1959)



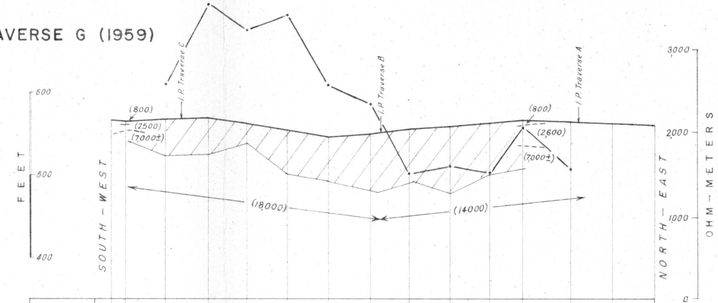
Station No.	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Surface Level	581.6	618.3	637.6	664.1	669.8	692.1	705.6	714.3	715.5	712.0	711.6	710.3	710.0	709.8	709.3	708.8	706.7
Depth to Bedrock			20'	24	34	32	30	32	38	33	49	43'	62	58	47		

TRAVERSE E (1959)



Station No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Surface Level	704.3	709.2	719.5	714.8		715.2	702.8	708.8	689.8	687.6	701.4	687.4	696.8	690.4	684.6	700.4	704.0
Depth to Bedrock			96	100	75	82	55	54	40	48	52	35	37	46	45	33	

TRAVERSE G (1959)



Station No.	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Surface Level	568.8	560.5	568.2	569.2	562.1	554.7	546.0	544.6	554.9	558.0	562.0	566.5	568.8	561.6	553.4
Depth to Bedrock	26	41	38	22	48	50	70	61	77	57	54				

LEGEND

- OVERBURDEN
- BEDROCK
- (12,000) SEISMIC VELOCITY IN FT./SEC.
- (7000±) SEISMIC VELOCITY IN FT./SEC. IN WHICH THE POSSIBLE ERROR OF DETERMINATION IS CONSIDERED GREATER THAN 10%.
- I.P. INTERSECTION POINT
- DH 6503 DRILL HOLE

HORIZONTAL SCALE IN FEET
100 0 100 200 300
VERTICAL SCALE AS SHOWN

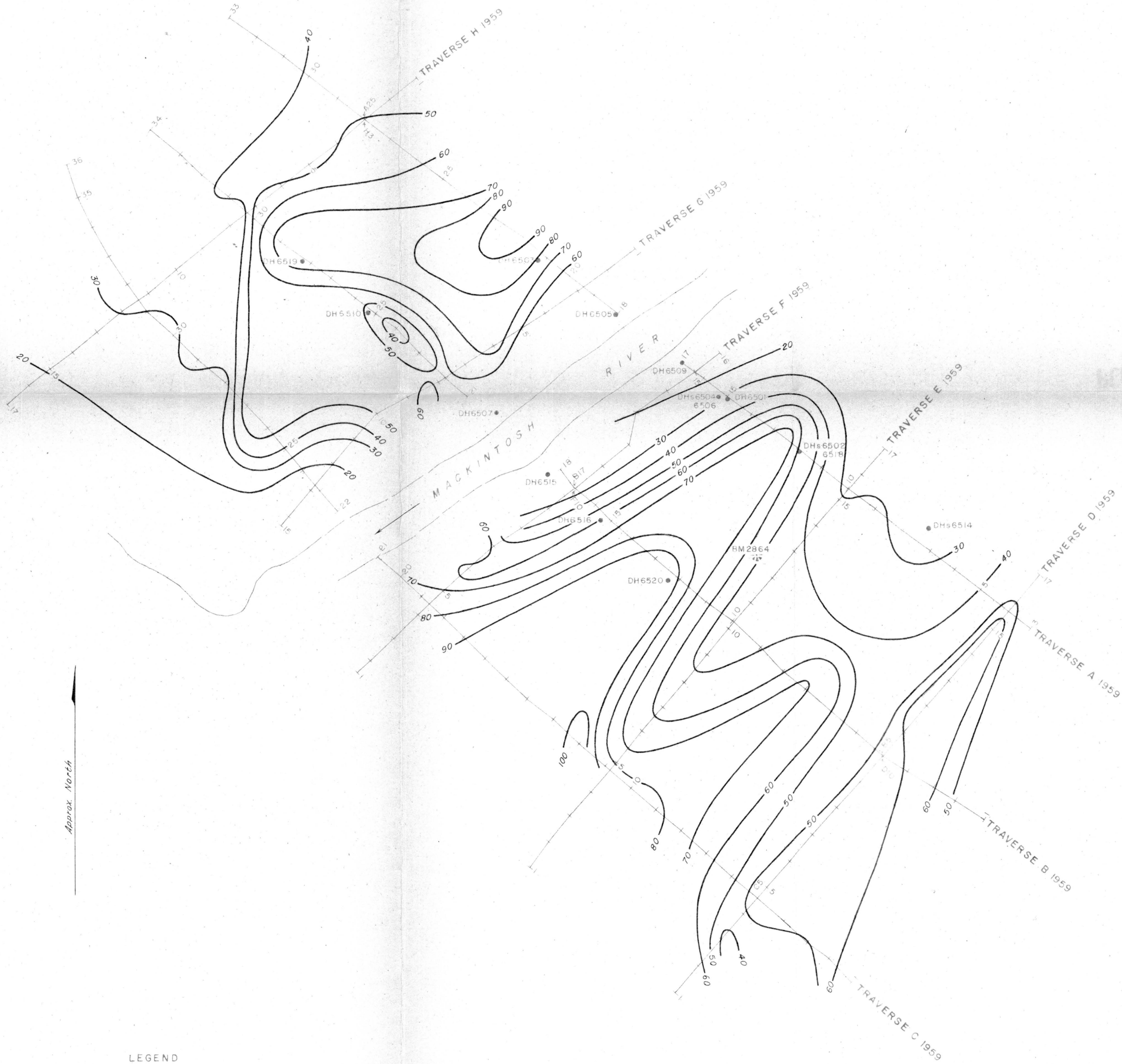
GEOPHYSICAL INVESTIGATIONS, MACKINTOSH RIVER DAM SITE, TASMANIA, 1959

INTERPRETATION OF SEISMIC SURVEY, AND RESISTIVITY PROFILES (100 FT. SPACING)

TRAVERSES D, E, F, G and H (1959)

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. G 279-6

PLATE 5



GEOPHYSICAL INVESTIGATIONS MACKINTOSH RIVER DAM SITE TASMANIA, 1959

CONTOURS SHOWING THICKNESS OF OVERBURDEN

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics G 279-11

TO ACCOMPANY RECORDS, 1959 No 148

TRAVERSE A 1957
TRAVERSE B 1957
TRAVERSE C 1957
TRAVERSE D 1957
TRAVERSE E 1957
TRAVERSE F 1957
TRAVERSE H 1957

MACKINTOSH RIVER

Floater
DH6503
DH6505
DH6507
DH6508
DH6510
DH6515
DH6519
DH6520
DHs 6501
DHs 6502 6518
DHs 6504 6506
DHs 6509 6511
DHs 6514 6521
BM2864

Dundas Group

Owen Conglomerate

Approximate contact between Dundas Group and Owen Conglomerate

Approx North

LEGEND

- DH6501 ● — DRILL HOLE
- BM2864 — BENCH MARK
- 5 — TRAVERSE
- 2 — RESISTIVITY CONTOUR (1000 OHM-M INTERVAL)
- LOW RIDGE
- WATERCOURSE
- SCREE
- RIVER GRAVEL
- TERRACE AREA
- OWEN CONGLOMERATE
- DUNDAS GROUP ROCKS (PHYLLITES, SLATES, TUFFS AND GRAYWACKE)

SCALE IN FEET
100 75 50 25 0 100 200 300

GEOPHYSICAL INVESTIGATIONS
MACKINTOSH RIVER DAM SITE, TASMANIA, 1959

RESISTIVITY CONTOURS, GEOLOGY AND TRAVERSES, (1957)

GEOLOGY AFTER R.R. MATHER H.E.C.

Geophysical Section, Bureau of Mineral Resources, Geology and Geophysics G 279-7