COMMONWEALTH OF AUSTRALIA
DEPARTMENT OF NATIONAL DEVELOPMENT
BUREAU OF MINERAL RESOURCES,
GEOLOGY AND GEOPHYSICS

RECORDS 1956, No. 69

PRELIMINARY REPORT ON A GEOPHYSICAL SURVEY OF THE GREAT LAKE NORTH AREA, TASMANIA

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Preliminary Report on a Geophysical Survey of the Great Lake North Area, Tasmania.

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The Hydro-Electric Commission of Tasmania proposes to build a power station using a water-drop of approximately 2,700 feet and with an output of 480,000 H.P., near Blackwood, about 36 miles south of Launceston. The water from this power station will subsequently be fed into the existing Trevallyn Scheme.

The scheme (see Plate 1) consists of an intake tunnel from the Great Lake to the slope of the Great Western Tiers (approx. length 23,000 feet), penstock lines, a vertical pressure shaft feeding an underground power-station, and a tail-race tunnel to the Palmer River.

The Commission applied to the Bureau for a geophysical survey to be made over part of the intake tunnel, penstock lines and the tail-race tunnel. The application was agreed to and the Bureau carried out the survey during the period February to May, 1956.

The purposes of the geophysical survey were:-

(a) To determine the depth of weathering and to detect any shear-zones over 5,500 feet of the western part of the intake tunnel. Seismic refraction, resistivity (constant electrode spacing of 50, 100 and 200 feet and 17 depth probes), magnetic and radioactive methods were used.

(b) To determine the thickness of the scree and to detect any shear-zones within the portal area at the eastern end of the tunnel. Seismic refraction, magnetic and radioactive methods were used. The resistivity method could not be used because satisfactory electrical contacts could not be obtained in the scree.

(c) To determine the thickness of the soil and the weathered layer, and possibly the type of rock below the weathered layer within the penstock lines area. Seismic refraction, resistivity (electrode spacing 50, 100 and 200 feet), magnetic and radioactive methods were used.

(d) To detect any faults and shear zones along the tail-race tunnel. Only the resistivity method was used (electrode spacing 50, 100 and 200 feet).

The following notes will serve to explain briefly the complex geological structure of the area (see Plate 1). At the western end, the intake tunnel will be in dolerite for the first 5,000 feet and will then pass into Triassic sediments (Newtown Coal Measures and Tiers Sandstones). Little is known about the geological structure from that point to the portal area, but it is believed that at 1,200 foot depth and under a dolerite cover, no serious difficulties will be met when driving the tunnel. In the portal area the rocks are obscured by scree, but it is known that the dolerite pinches out toward DH5033. The outlet of the tunnel will be in Cluan Sandstone (Triassic).

The upper part of the penstock-lines will be in Triassic rocks (Ross Sandstone) and the lower part in Permian rocks (Ferntree Mudstones). The tail-race tunnel will be in Permian rocks (Golden Valley Mudstones).

The results of the survey are shown on Plates 2 to 7 in the form of geophysical profiles and their interpretation in terms of rock types and shears, fractures or fault zones. It is emphasised that the interpretation is a preliminary one and may be modified after further analysis of the results. It is based mainly on the following criteria:-

(a) Resistivity Method.

The apparent resistivity of the near-surface layers corresponding to electrode separations of 50, 100 and 200 feet of a standard Wenner configuration givesevidence of the way in which the electrical resistivity changes with depth. In general, hard unweathered rocks have a high resistivity and their weathered counterparts low resistivity. Shearing and fracturing of the rocks result in a considerable lowering of the resistivity due to increased water content and to weathering along the zones. Therefore shears and faults are indicated by low apparent resistivity. The absolute values of the resistivities are not so important in interpretation as sudden transitions from high to low resistivity values which indicate transitions from hard unweathered rock to sheared and fractured rock.

(b) Seismic Method.

The velocity of seismic waves in the near-surface layers is measured, and also depths to interfaces between geological formations which have different seismic velocities. Hard, unweathered rocks have higher velocities than their weathered and fractured counterparts. In the area of the present investigations, unweathered dolerite has a velocity of 15,000 to 20,000 ft./sec., and unweathered sediments 8,000 to 10,000 ft./sec.; their fractured, sheared and weathered counterparts have lower velocities, the decrease in velocity being directly related to the degree of shearing, etc. The velocity in soil and scree material is considerably lower than in the weathered and sheared rocks. The depth of weathering increases considerably over sheared and fractured zones and this factor is made use of in the interpretation.

(c) Magnetic Method.

Different rock types have different magnetic susceptibilities and these affect the strength of the magnetic field measured at the surface. Magnetic measurements can, in some areas, indicate boundaries between different types of near-surface formations. On the intake tunnel the magnetic intensity is proportional to the thickness of the scree and the weathered layer.

(d) Radioactive Method.

Under favourable conditions, it is possible for radon to be concentrated in sheared and fractured zones, and this results in an increase in natural radioactivity over such features. However, deep soil or scree generally obscures or disperses the effect, and nothing of interest was obtained in the tests by this method in this area.

In general, results are influenced largely by the effects of near-surface layers, and the interpretation applies mainly to these layers. In tunnel line investigations, such as those described herein, it is inferred on the basis of geological probability that sheared and fractured zones detected near the surface extend in depth to the level of the proposed tunnel.

Previous experience has shown that this is a reasonable inference.

Plate 2 shows the geophysical results along the part of the intake tunnel between 700 feet and 6,500 feet. Probable shear zones at tunnel level are indicated.

Plate 3 shows in more detail the thickness of alluvium, scree and weathered dolerite along the part of the intake tunnel line between 700 feet and 5,500 feet.

Plate 4 shows the geophysical results in the portal and penstock area and a cross-section based on geological and geophysical data.

Plate 5 shows a detailed section of the portal area based on the seismic results.

Plate 6 shows a detailed cross-section of the penstock lines area based on the seismic results.

Plate 7 shows the constant-spacing resistivity profiles along the first 9,600 feet of the tail-race tunnel. Probable shear zones at tunnel level are indicated.

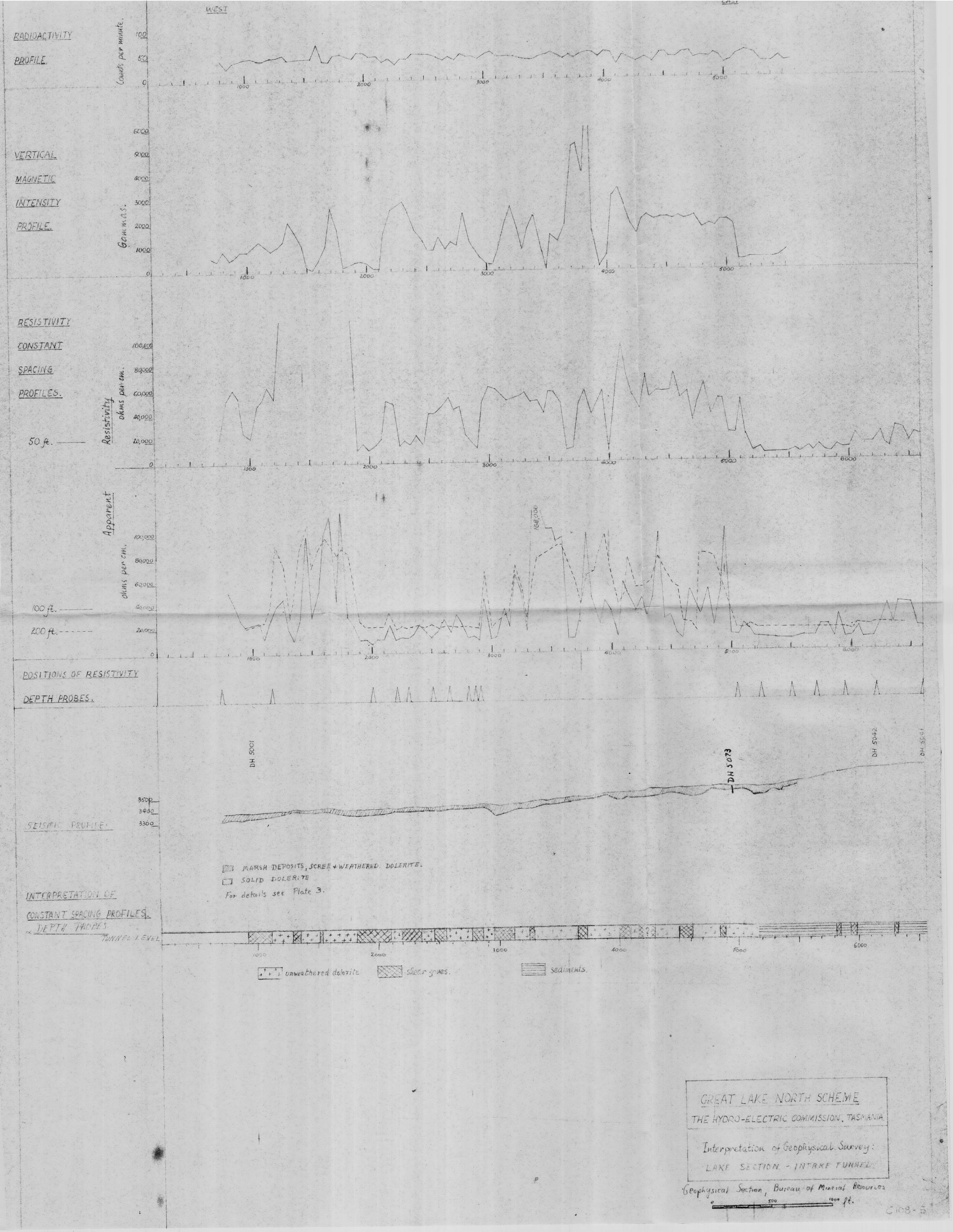
The determinations of thickness of scree and weathered dolerite from the seismic work on the intake tunnel line are considered to have an accuracy of about ± 15%. Drill-hole 5073 was used as a control. However, it was difficult to determine accurately the lower limit of the partly weathered (or jointed) dolerite because of the gradual transition between partly weathered and unweathered dolerite.

In the portal area, control for the seismic interpretation was provided by drill-holes 5030, 5031 and 5032, and vertical velocities were determined in test pits. It is therefore considered that the section between DH 5031 and DH 5032 has been determined with possible error of ± 10 per cent.

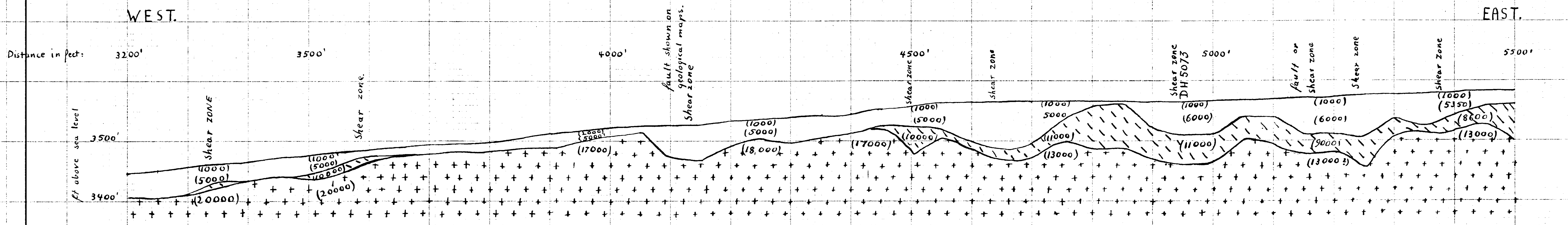
The profile of the part of the portal area between DH 5032 and the cliff edge, where unweathered dolerite crops out, was computed by a method of step-out times using DH 5032 as a control. The accuracy is expected to be high. This was confirmed at DH 5033 where the seismic results indicated unweathered dolerite underneath the scree at 360 feet and subsequently the drill hole showed unweathered dolerite between 362 feet and 432 feet.

No control data are available for the penstock-lines area but it is considered that the thickness of soil (low-velocity layer) has been determined with an accuracy of ± 10 per cent. The accuracy in determining the thickness of the weathered sediments is probably not so high and the error may be as much as ± 25 per cent.


PLATE 1
Great Lake
Geophysical traverses shown thus
Tunnel Line
The Bluff
SANDSTONE
CREEK
East Branch
INTAKE TUNNEL
PORTAL AREA
PENSTOCK LINE
TAIL-RACE TUNNEL
Great Lake
Sea level
LEGEND
RECENT TO TERTIARY
Alluvium
Talus & Scree
JURASSIC
Dolerite
TRIASSIC
Newtown Coal Measures.
Tiers Sandstones.
Cluan Sandstones.
Ross Sandstones.
Jackey Shales.
PERMIAN
Blackwood Conglomerate
Palmer Sandstone
Risdon Sandstone
Ferntree Mudstones
Woodbridge Tillitic Mudstones
Liffey Sandstone
Golden Valley — Quamby Group Mudstones & Calcareous Mudstones
Stockers Tillite
Fault
Fault — Position Approximate.
Fault — Indicated by Gravity Survey
Major Gravity Anomaly
1952 SURVEY
Formation Boundary
Lake Boundary
Trig Station
Diamond Drill Hole
TASMANIA
Great Lake North Scheme
Scale of Miles
Note: Geology based on HEC Maps.
GREAT LAKE NORTH SCHEME
THE HYDRO-ELECTRIC COMMISSION, TASMANIA
Locality map, geology and geophysical traverses
0 1000 2000 3000 4000 ft
(Natural Scale)
Geophysical Section, Bureau of Mineral Resources
G108-4



WEST
EAST
RADIOACTIVITY PROFILE.
Counts per minute.
100
50
0
1000
2000
3000
4000
5000
VERTICAL MAGNETIC INTENSITY PROFILE.
Gammas.
6000
5000
4000
3000
2000
1000
RESISTIVITY CONSTANT SPACING PROFILES.
Resistivity ohms per cm.
100,000
80,000
60,000
40,000
20,000
50 ft.
Apparent ohms per cm.
168,000
100 ft.
200 ft.
POSITIONS OF RESISTIVITY DEPTH PROBES.
DH 5001
DH 5073
DH 5042
DH 5041
3500
3400
3300
SEISMIC PROFILE.
MARSH DEPOSITS, SCREE + WEATHERED DOLERITE.
SOLID DOLERITE
For details see Plate 3.
INTERPRETATION OF CONSTANT SPACING PROFILES. + DEPTH PROBES.
TUNNEL LEVEL
unweathered dolerite.
shear zones.
sediments.
GREAT LAKE NORTH SCHEME
THE HYDRO-ELECTRIC COMMISSION, TASMANIA.
Interpretation of Geophysical Survey:
LAKE SECTION - INTAKE TUNNEL.
Geophysical Section, Bureau of Mineral Resources
0
500
1000 ft.
G108-3



(0000) Seismic velocity in feet per second.

☐ ALLUVIUM, SCREE & WEATHERED DOLERITE.

☐ PARTLY WEATHERED (OR JOINTED) DOLERITE

☐ UNWEATHERED DOLERITE

NOTE: Thickness of strata calculated from seismic results.
Shear zones obtained from Resistivity Results. (see Plate 2.)

GREAT LAKE NORTH SCHEME

THE HYDRO-ELECTRIC COMMISSION, TASMANIA

Interpretation of Geophysical Survey.

LAKE SECTION - INTAKE TUNNEL.

Scale 0 50 100 200 ft (natural)

Geophysical Section, Bureau of Mineral Resources.

G108-3


RADIOACTIVITY PROFILE
Counts per minute.
VERTICAL MAGNETIC INTENSITY PROFILE
Gammas.
RESISTIVITY CONSTANT SPACING PROFILES.
50 ft.
Resistivity, 1000 ohms per cm.
Apparent 1000 ohms per cm.
100 ft.
200 ft.
Proposed tunnel line.
Base of Cluan Sandstones & Mudstones
Base of Ross Sandstone
Base of Jackey Shales
Base of Ferntree Mudstones
DH 5035 (VERTICAL SHAFT)
DH 5034 (POWER STATION)
DH 5033 Drill-hole

GREAT LAKE NORTH SCHEME

THE HYDRO-ELECTRIC COMMISSION, TASMANIA.

PORTAL AREA

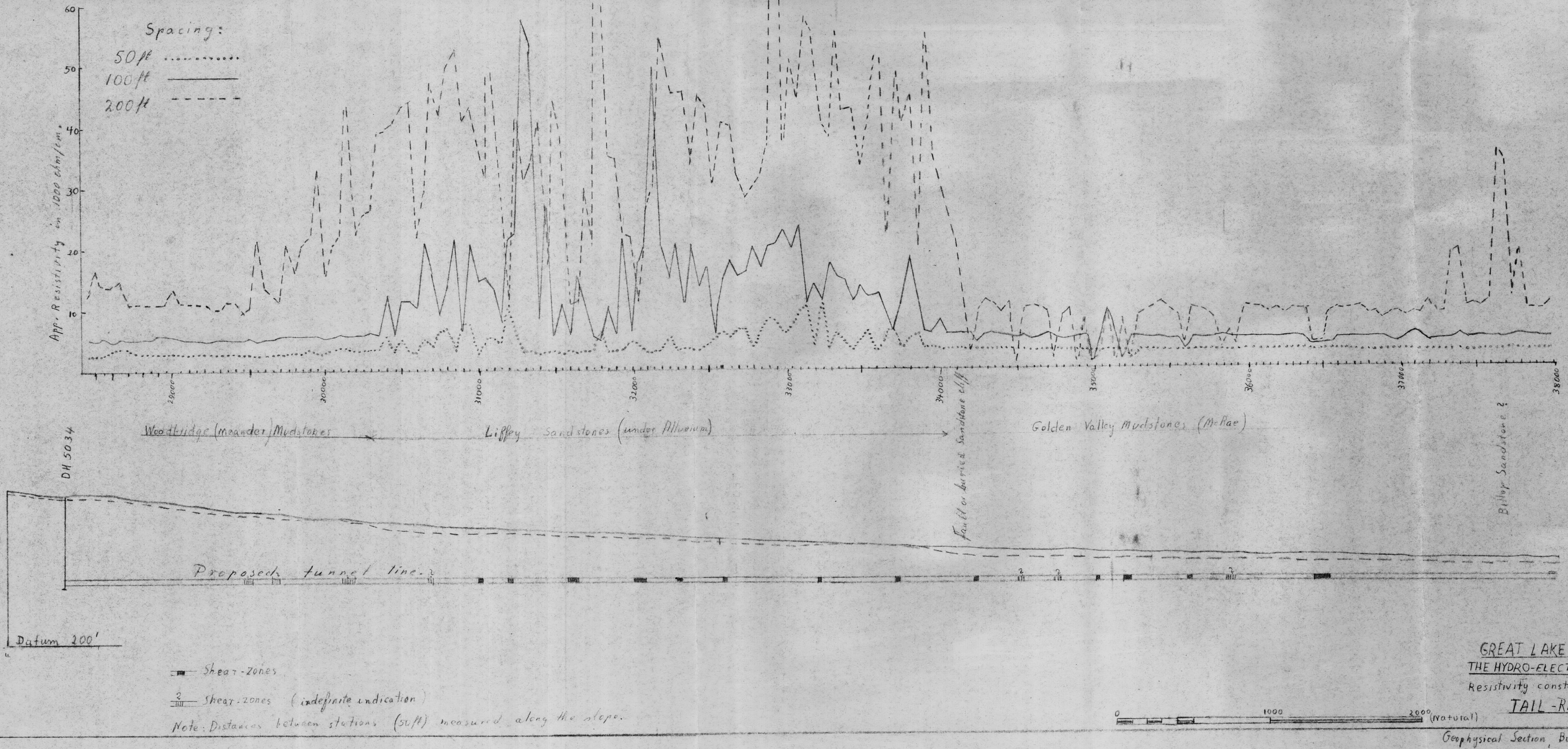
Interpretation of Seismic Profiles.

Geophysical Section, Bureau of Mineral Resources

G108-8


24000'
24500'
25000'
25500'
26000'
26500'
27000'
27500'
28000'
(5500) Seismic velocity in ft/sec
Soil
Weathered sediments
Unweathered sediments
Note: Thickness of strata obtained from seismic survey
Distances between stations measured along slope.
Scale 0 50' 100' 200' (Natural)
GREAT LAKE NORTH SCHEME
THE HYDRO-ELECTRIC COMMISSION TASMANIA
PENSTOCK LINE
Interpretation of Seismic Profiles
Geophysical Section, Bureau of Mineral Resources.

PLATE 7.



GREAT LAKE NORTH SCHEME

THE HYDRO-ELECTRIC COMMISSION, TASMANIA

Resistivity constant spacing profiles

TAIL-RACE TUNNEL

G108-10

Geophysical Section, Bureau of Mineral Resources.