COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES,
GEOLOGY AND GEOPHYSICS

RECORDS 1956, No. 142

GEOPHYSICAL SURVEY OF THE PROPOSED CLEVELAND TUNNEL LINE, TASMANIA

by

W. A. WIEBENGA and D. F. DYSON

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ILLUSTRATIONS.

ABSTRACT

The survey described in this report was made on behalf of the Tasmanian Hydro-Electric Commission, along the line of the proposed Cleveland Tunnel, through the hill between the Derwent and Dee Rivers. It was intended to carry out reconnaissance resistivity and magnetic surveys to obtain information on the geological boundaries beneath the surface material, and to follow these with a seismic survey to obtain accurate estimates of the thickness of the basalt and the depth to the dolerite basement. During the course of the survey, however, the Commission decided to abandon the tunnel project, and only the resistivity and magnetic surveys were completed.

The results indicate to what extent the tunnel line area is covered by basalt, and show that the tunnel would probably be located in sedimentary rocks. Several shear and/or fracture zones were indicated.

1. INTRODUCTION

As part of the Derwent-Dee Power Development Scheme, the Hydro-Electric Commission of Tasmania proposed to build a tunnel (the Cleveland Tunnel) to divert water from the Derwent River to the Dee River (Plate 1), and applied to the Commonwealth Bureau of Mineral Resources for a geophysical survey to be made to supplement information available from an earlier geological survey and drilling investigations. The request was agreed to by the Bureau and the survey was commenced in March, 1955.

It was intended to carry out reconnaissance resistivity and magnetic surveys along the full length of the proposed tunnel line, and to follow these by a detailed seismic survey. Before the geophysical investigations had been completed, however, the Commission decided that the construction of the proposed tunnel would be uneconomical as compared with alternative plans. The investigations were therefore terminated in April, 1955, by which time only the resistivity and magnetic surveys had been completed.

The surveys were carried out by a geophysical party based at Wayatinah and consisting of D.F. Dyson (party leader) and M.J. O'Connor, geophysicists, and J.P. Pigott, field assistant. A topographical survey party and one field assistant were provided by the Commission.

It is desired to acknowledge the ready co-operation of personnel of the Resident Engineer's Office, Wayatinah.

2. GEOLOGY.

It was intended that the tunnel would pass through the hill between the Derwent and Dee rivers (Plate 2). The following notes on the geology of the area are taken from a report by Mather (1955) and from geological logs of drill holes 8900, 8901 and 8902.

The following rock types are present :-

(i) Sedimentary rocks.

These consist of felspathic sandstones and mudstones of Triassic (?) age. At the surface, the sedimentary rocks are, in general, covered by soil and/or basalt or basalt float.

(ii) Dolerite.

Dolerite crops out near the western end of the proposed tunnel line, and is a fine-grained to medium-grained rock in which several shear zones are present.

(iii) Basalt.

Tertiary basalt occurs as a thin lava flow over the eastern end of the tunnel line and forms a capping on the ridge north of the tunnel line. Basalt talus cover over most of the area makes surface geological mapping difficult. The basalt flowed over the old eroded land surface of dolerite and sedimentary rocks. It appears that the level of the proposed tunnel would be below that of the bottom of the basalt flows.

(iv) Terrace material and alluvial deposits.

Although not present along the proposed tunnel line, terrace material occurs near both the inlet and portal areas.

Results of drilling investigations show that the sedimentary rocks are 38 feet thick in D.H. 8900 and 41 feet thick in D.H. 8901. The section in D.H.8902 consists of 9 feet of soil, 27 feet of basalt, and 231 feet of argillites, siltstones and sandstones; this hole terminates in sandstone.

The purposes of the survey were to obtain an estimate of the depth to the dolerite underlying the sedimentary rocks and to determine the extent of the basalt flows along the tunnel line.

3. METHODS OF SURVEY.

The resistivity and magnetic surveys were made to obtain information on the geological boundaries beneath the soil and the float. One traverse was pegged along the tunnel line and 10 traverses at 1,000-foot intervals at right angles to the tunnel line.

(i) Resistivity survey.

The method used is described by Quilty (1953). A Geophysical Megger was used, and continuous resistivity profiles were obtained using the Wenner configuration and constant electrode spacings of 20 feet, 80 feet and 160 feet.

(ii) Magnetic survey.

Previous magnetic surveys carried out by the Bureau of Mineral Resources in Tasmania have shown that undulations in the surface of dolerite underlying sedimentary rocks show a fair degree of correlation with the magnetic intensity measured at the surface.

Readings were taken at 40-foot intervals along the traverses, using a Watts vertical variometer with a scale factor of 47 gammas per division.

4. RESULTS.

The magnetic and resistivity profiles along the tunnel line traverse are shown on Plate 3 and those along the 10 cross-traverses on Plate 4, Sheets 1 and 2. The jagged appearance of the magnetic profile between stations R414 and R564 is due to irregular polarisation of the basalt flow at, and near, the surface.

Both the magnetic and resistivity profiles indicate several shear or fracture zones with weathering associated with them. These are located near stations R100 , R376, R442, R475, R550, and possibly at R522 and R566.

The contours of vertical magnetic intensity are shown on Plate 5. The area enclosed by the 5000-gamma contour agrees approximately with the area of outcropping dolerite. At D.H. 8902, where the vertical magnetic intensity is 1,600 gammas, the depth to the surface of the dolerite is at least 267 feet, i.e. below the proposed level of the tunnel. As the vertical magnetic intensity along the rest of the tunnel line is less than 1,600 gammas, it is considered that the whole length of the proposed tunnel would be in sedimentary rocks, overlying the dolerite.

The photo maps of the Derwent-Dee Valley suggest a fracture and/or shear pattern with east-west, north-south, and north-60° east strikes. This pattern appears to be superimposed on the sedimentary rocks (Triassic ?), dolerite and basalt.

5. CONCLUSIONS AND RECOMMENDATIONS.

The combined results of the geophysical, geological and drilling investigations suggest that the proposed tunnel would be located entirely in sedimentary rocks, between the underlying dolerite and the overlying basalt. The geophysical survey indicated the presence of basalt at the surface and along the tunnel line between stations R414 and R564. Several probable shear and/or fracture zones were indicated.

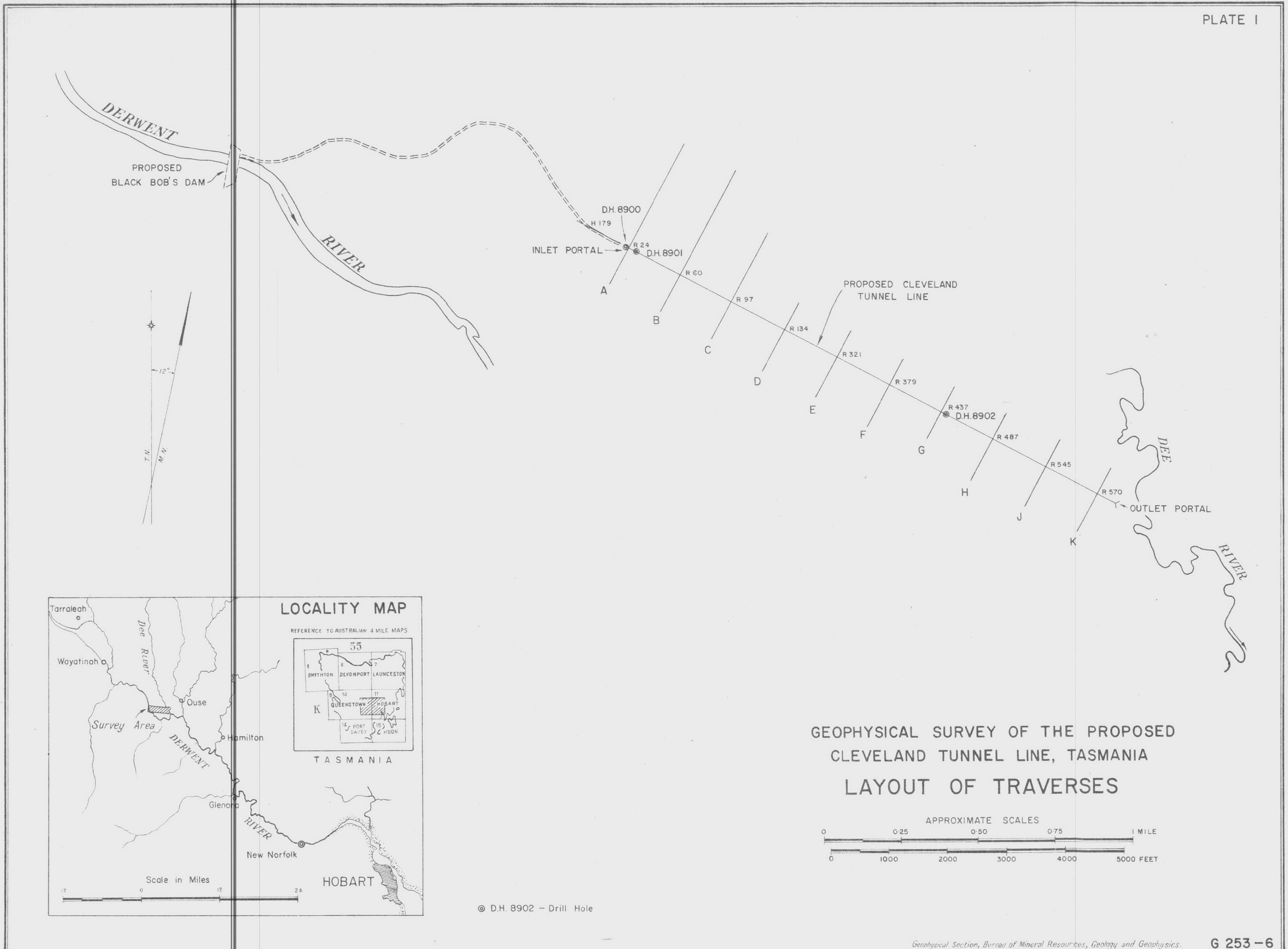
If, at any later date, it is decided to proceed with the construction of the Cleveland Tunnel, it is recommended that seismic refraction and reflection surveys be made in advance to determine the thickness of the basalt and the depth to the surface of the dolerite. Such surveys would not be straight-forward and may involve some experimentation, because of the presence of a high-velocity formation (basalt) overlying a low-velocity formation (sedimentary rocks).

6. REFERENCE.

Quilty, J.H., 1953 - Geophysical Survey of the Trevallyn Tunnel Line, Launceston, Tasmania. Bur. Min. Resour., Aust., Records 1953, No. 59.

Mather, R.P., 1955 - Geological Notes on the proposed Cleveland Tunnel line Hydro-electric Commission, Tasmania.

PLATE I



GEOPHYSICAL SURVEY OF THE PROPOSED
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LAYOUT OF TRAVERSES

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PLATE 2
Basalt float with some outcrop
Basalt float with some outcrop
Dolerite
Float and outcrop
Basalt float and outcrop
Basalt float and outcrop
TUNNEL
LINE
INLET PORTAL
OUTLET PORTAL
Dolerite and Basalt float
Silt and Mts float
Basalt float
Dolerite float
with some outcrop
Dolerite float
Sandstone float
with some
outcrop
Basalt float and outcrop
Basalt and
"grey billy" float
Basalt float
Dolerite float
DEE
RIVER
N 773 KYDS
E 456 KYDS
E 457 KYDS
N 772 KYDS
E 458 KYDS
E 459 KYDS
600
700
800
900
1000
1100
1200
Dolerite and Basalt float
Dolerite float
Basalt float
Basalt float
Basalt float and outcrop
Sandstone float
Basalt float
INLET
OUTLET
DEE RIVER
LEGEND
BASALT
DOLERITE
SANDSTONE
MUDSTONE
FLOAT
APPROX BOUNDARY
SHEAR OR JOINT
HORIZONTAL AND VERTICAL SCALES IN FEET
400
0
400
800
1200
1600
CONTOUR INTERVAL 100 FEET
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CLEVELAND TUNNEL LINE, TASMANIA
GEOLOGICAL MAP AND CROSS-SECTION
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PLATE 3

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PLATE 4
SHEET 1

GEOPHYSICAL SURVEY OF THE PROPOSED
CLEVELAND TUNNEL LINE, TASMANIA

MAGNETIC AND RESISTIVITY PROFILES

CROSS TRAVERSES A to D

SCALES

HORIZONTAL 400 – 0 – 400 – 800 FEET
VERTICAL: RESISTIVITY 10 – 0 – 10 – 20 OHM-METRES.
MAGNETIC 500 – 0 – 500 – 1000 GAMMAS

LEGEND

CONSTANT ELECTRODE SPACING

- o—o—o—o 20 Feet spacing
- x- -x- -x- -x 80 " "
- ·—·—·— 100 " "
- +·····+·····+ MAGNETIC PROFILE

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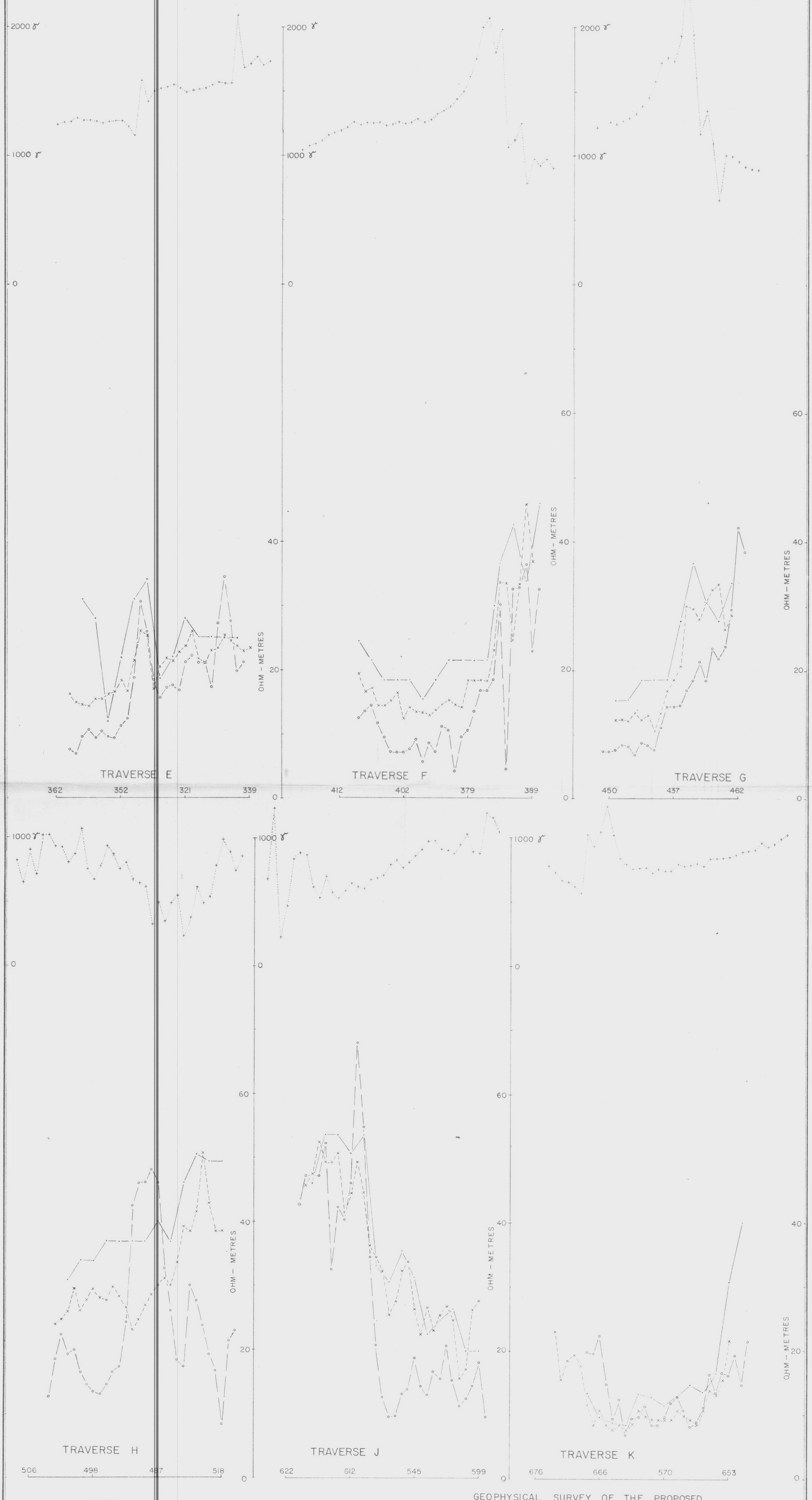
PLATE 4
SHEET 2



LEGEND
CONSTANT ELECTRODE SPACING
20 Feet spacing
80 " "
100 " "
MAGNETIC PROFILE

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GEOPHYSICIST

GEOPHYSICAL SURVEY OF THE PROPOSED
CLEVELAND TUNNEL LINE, TASMANIA

MAGNETIC AND RESISTIVITY PROFILES

CROSS TRAVERSES E to K

HORIZONTAL 400 0 400 800 FEET
VERTICAL RESISTIVITY 10 0 10 20 OHM-METRES
MAGNETIC 500 0 500 1000 GAMMAS

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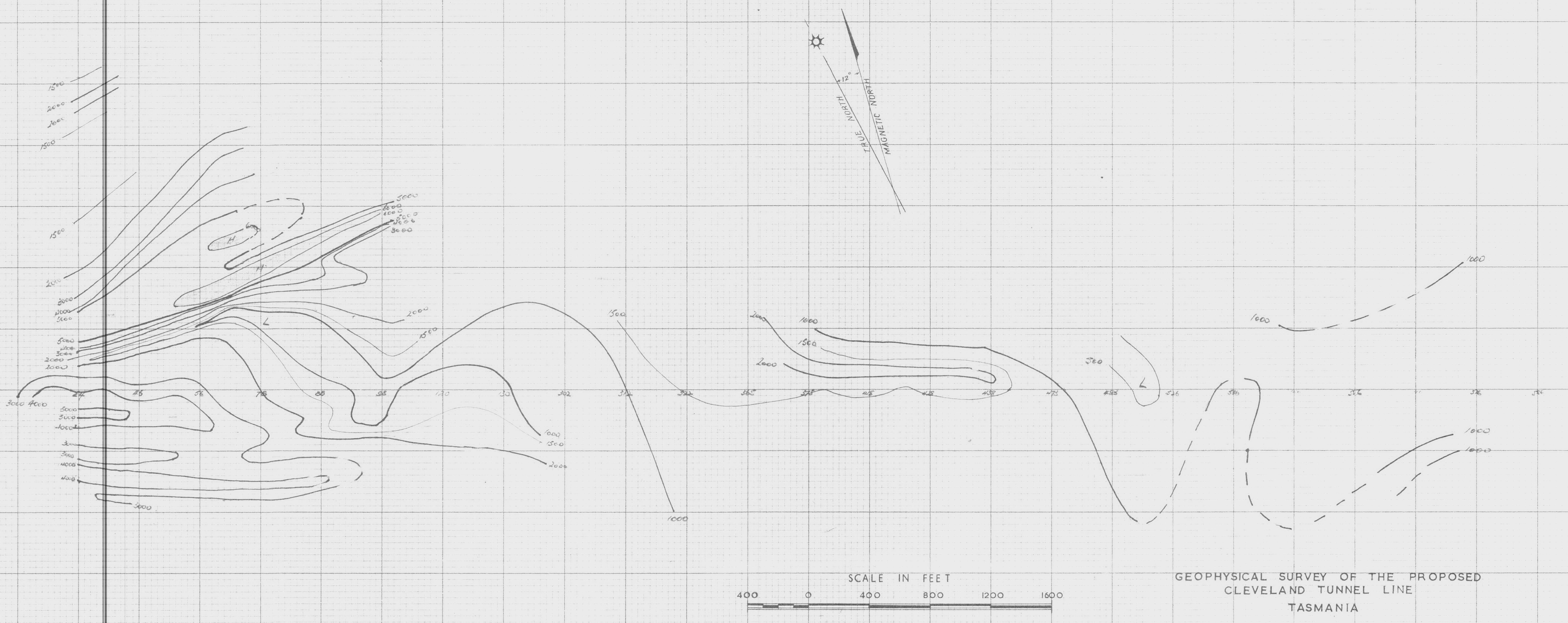

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TASMANIA

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VERTICAL MAGNETIC INTENSITY CONTOURS

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