COMMONWEALTH OF AUSTRALIA

# DEPARTMENT OF NATIONAL DEVELOPMENT

# BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS



RECORD No. 1962/178



## ARTHUR LAKES DIVERSION AQUEDUCT, SEISMIC SURVEY, TASMANIA 1962

by

W.A. Wiebenga and E.J. Polak

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## ILLUSTRATIONS



## SUMMARY


This Record describes a seismic refraction survey requested by the Hydro-Electric Commission of Tasmania.

The Commission intends building an unlined flume, and the survey was made to select a site where scouring would not be excessive.

## 1. INTRODUCTION

In order to increase the amount of water in Great Lake for the Poatina Power Station, the Hydro-Electric Commission (HEC) of Tasmania proposes to pump water from Arthur Lakes along an unlined flume to a point on Great Lake, south of Todd's Corner. The approximate co-ordinates of the outflow of the flume are 472831, referring to the Devonport sheet of the Australian 4-mile series of maps.

The water in the unlined flume could scour out the rocks, causing excessive silt deposition in Great Lake.

To investigate this problem, information is required about the nature of the rocks along the flume line. Therefore, the Commission requested the Bureau of Mineral Resources to conduct a geophysical survey along the proposed flume line. The survey was done in February 1962 by a geophysical party consisting of E.J. Polak (party leader), J.T.G. Andrew (geophysicist), and J.P. Pigott (geophysical assistant).

The Commission provided a staff member, D. Hansen, to be trained in engineering geophysics; it also supplied geophysical assistants, and did the topographical surveying of the traverses (see Plate 1).

A seismic refraction technique, the 'method of differences', was used. This method has been described in previous BMR Records and is also described by Heiland (1946) and Stam (1962).

The equipment consisted of a 24-channel SIE recording camera, a bank of 12 SIE amplifiers, a bank of 12 Midwestern amplifiers, and 24 TIC geophones with a natural frequency of about 20 c/s.

## 2. GEOLOGY

The following geological notes were supplied by G. Hale, the Commission's Geologist-in-Charge.

Between the outlet from Arthur Lakes flume and Great Lake at Todd's Corner, is a marshy depression 6400 ft long. Dolerite occurs along the eastern margin and basalt occurs along the western margin. It appears that the valley has developed along the boundary of a basalt flow where it has lapped against the underlying dolerite. The valley floor is now covered by peat, gravel, and clay of unknown thickness. A geophysical survey was requested to help in the determination of depth and type of material along the valley.

## 3. RESULTS

The results of the survey are shown as seismic cross-sections on Plates 2, 3 and 4.

Velocities

Seismic velocities, as measured by the seismic refraction method, vary with the porosity and strength of a rock. Therefore seismic velocities may be used to indicate, within certain limits, rock type and also rock quality or strength, which is important in civil engineering. Table 1 gives the measured seismic velocities with the corresponding rock types.

TABLE 1

| Seismic Velocity (ft/sec) | Rock type | Reference note |
|---|---|---|
| 1000 to 1600 | Surface layer, soil | |
| 3100 to 6200 | Alluvium. In the lower velocity range, mainly water-saturated clays; in the higher velocity range, mainly gravel and boulders. | (1) |
| 7000 to 14,300 | Weathered, porous basalts to slightly-weathered basalt of low porosity; weathered to slightly-weathered dolerite, fractured or sheared. | (2) |
| 16,000 to 22,000 | Unweathered dolerite | (3) |

Notes to Table 1

(1) The velocities in very-weathered basalt and dolerite may be as low as 3000 ft/sec. However, considering the general geology of the area, the measured velocities in the seismic cross-sections are interpreted as representing alluvium.

(2) At D12 (Plate 4) the 7100-ft/sec refractor may represent either weathered basalt, weathered dolerite, or semi-consolidated to consolidated coarse alluvial sediments. Some of the velocities between 10,000 and 14,200 ft/sec observed in the deepest refractor may be interpreted as being in either basalt or slightly weathered, sheared dolerite, e.g. along Traverse A (Plate 2) between A8 and A17, A27 and A31, A70 and A79, and A113 and A117.

(3) Some of the observed velocities of the deepest refractor in the 16,000 to 17,000 ft/sec range, may indicate massive basalt of low porosity. However, such basalts are not commonly found in Tasmania; therefore, these velocities were interpreted as representing dolerite.

Discussion

With the help of Table 1 the seismic cross-sections may be interpreted in geological terms.

If an unlined water flume is constructed it may be expected that most rocks in which the velocities are not greater than 6200 ft/sec (very weathered rocks or alluvium) will be scoured by flume water.

Most of the rocks occurring above the deepest refractor, in which the velocity is 8000 to 13,000 ft/sec, can probably be interpreted as weathered or porous basalt. These basalts may be expected to be resistant to water scouring if the flume-water velocities are not too high.

Seismic velocities ranging between 6000 and 8000 ft/sec in the intermediate layer (immediately above the deepest layer), e.g. those recorded near A79, A33, A19, A6, and D12, are probably associated with weathered basalt. It is doubtful whether the rocks in which these velocities occur would be resistant to water scouring even for moderate flume-water velocities. This opinion is based on past experience which shows that such rocks are relatively weak and do not resist mechanical weathering.

The thickness of low velocity overburden may be estimated from the seismic cross-section; it is less than 10 ft between G0 and G7, and between C6 and C12. Traverses G and E indicate that the low-velocity layers are thinning in the south-west, and it is probable that suitable conditions would be found west or south-west of A126 to A110 and of Traverses B, D, and E.

The deepest refractors observed along Traverses A, B, and C are interpreted as being dolerite. The observations indicate that the top surface of the deepest refractor dips steeply west to south-west (see cross-sections on Plate 4). In several places the recorded velocities along the deepest refractor are considerably lower than in neighbouring zones, e.g. between A8 and A17, A27 and A31, A49 and A50, B1 and B6, B10 and B15, B24 and B26, C8 and C9. These low-velocity zones may be interpreted as zones of either fractured or sheared dolerite, or perhaps as basalt in deep subsurface valleys of dolerite.

## 4. CONCLUSIONS

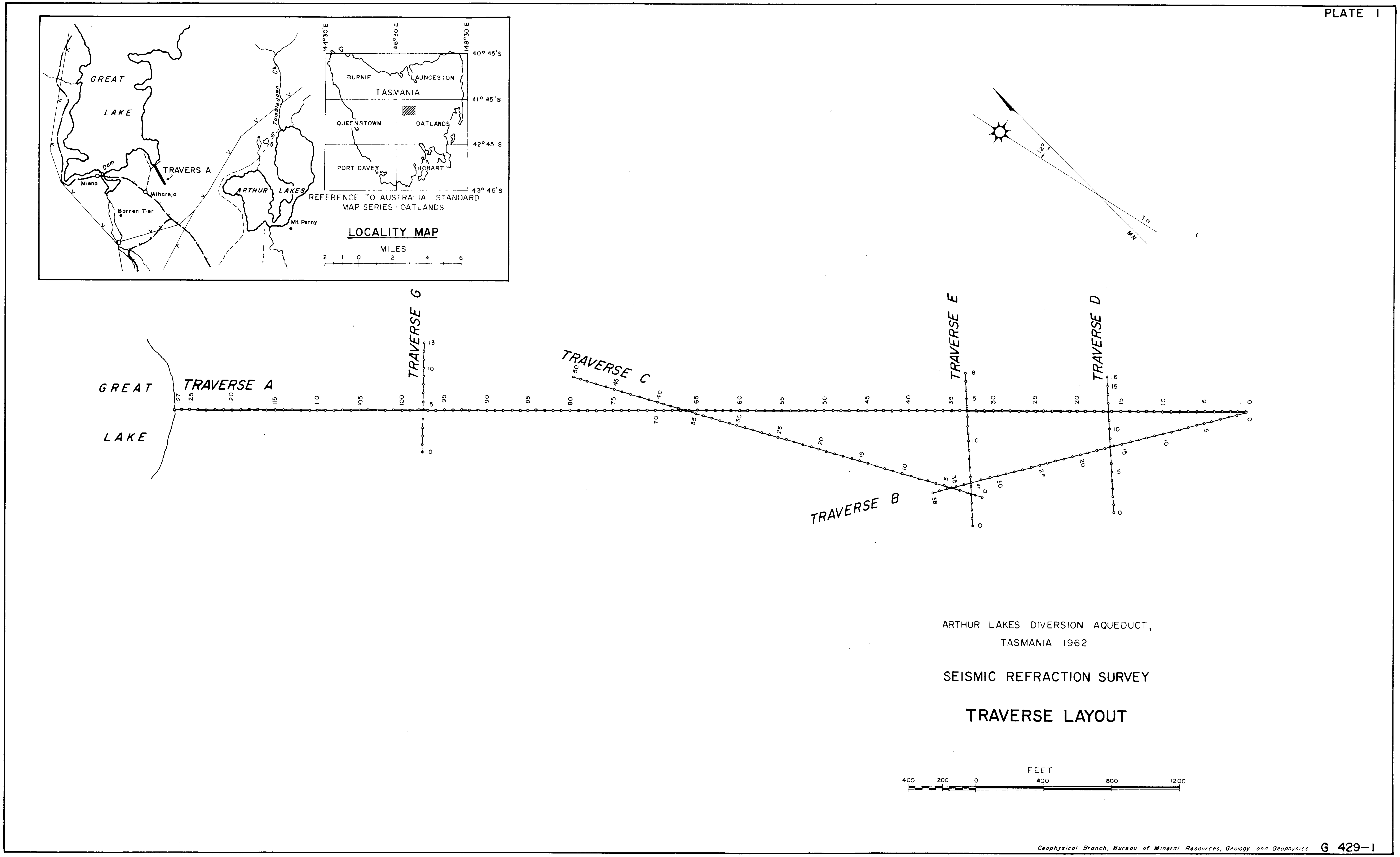
The discussion of the seismic cross-sections in the previous chapter shows that the best location for an unlined flume would be west or south-west of A110, G7, A78, and Traverse C.

If the area between B0 and C4 is used for an unlined flume, scouring may be expected, the amount of scouring being dependent on the water velocities in the flume. The same applies to the area between A110 and A126.

## 5. REFERENCES


HEILAND, C.A. 1946 GEOPHYSICAL EXPLORATION. New York, Prentice Hall. p. 548.

STAM, J.C. 1962 Modern developments in shallow seismic refraction techniques. Geophysics, 27, (2), 198-200.




ARTHUR LAKES DIVERSION AQUEDUCT,
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SEISMIC REFRACTION SURVEY

## TRAVERSE LAYOUT

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TO ACCOMPANY RECORD No 1962/178

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FEET

100 50 0 100 200 300

(Horizontal and Vertical)

LEGEND

| | |
|---|---|
| (5,000) | Formation with seismic velocity of 5,000 ft/sec |
| —— 67' | Depth to formation with different seismic velocity |
| I. P | Intersection point |
| •——•— | Unweathered bedrock boundary |

TRAVERSE A

## SEISMIC CROSS-SECTION

Based on H E C Plan A 9217

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TO ACCOMPANY RECORD No. 1962/178


FEET

100 50 0 100 200 300

(Horizontal and Vertical)

LEGEND

(5,700) Formation with seismic velocity of 5700 ft/sec

—— 82' Depth to formation with different seismic velocity

I.P. Intersection point

•——•— Unweathered bedrock boundary

TRAVERSES B and C

## SEISMIC CROSS-SECTIONS

Based on H E C Plan A 9218

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics G 429-2

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FEET

100 50 0 100 200 300

(Horizontal and Vertical)

LEGEND

(8,000) Formation with seismic velocity of 8000 ft/sec.

— 28' Depth to formation with different seismic velocity

I. P Intersection point

—·—·— Unweathered bedrock boundary

TRAVERSES D, E, and G

## SEISMIC CROSS-SECTIONS

Based on H E C Plan A 9219

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ARTHUR LAKES 'DIVERSION' AQUADUCT - TASMANIA - 1962.