DEPARTMENT OF
MINERALS AND ENERGY

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record 1973/9

MOLONGLO FREEWAY, BLACK MOUNTAIN, A.C.T. SEISMIC SURVEY, 1972

by

I.D. Bishop and B.H. Dolan

Record 1973/9

MOLONGLO FREEWAY, BLACK MOUNTAIN, A.C.T.
SEISMIC SURVEY, 1972

by

I.D. Bishop and B.H. Dolan

C O N T E N T S

ILLUSTRATIONS

SUMMARY

A seismic survey was carried out along the route of the proposed Molonglo Freeway near Black Mountain, A.C.T. to determine the nature of the bedrock and overburden and to delineate areas with large thicknesses of scree material. Part of the work was carried out on the lake adjacent to Black Mountain.

The thickness of overburden is generally about 7 metres but extends to about 20 metres in places. The bedrock is generally fractured.

1. INTRODUCTION

The National Capital Development Commission is planning the Molonglo freeway around the south side of Black Mountain (Plate 1.). To assist in planning and design, it was requested that the Bureau of Mineral Resources, Geology and Geophysics (BMR) carry out a seismic survey along the route of the freeway. The survey involved seismic refraction methods on land and water and seismic reflection on Lake Burley Griffin. The field work was carried out in June and July 1972 by a geophysical party from the BMR Engineering Geophysics Group. Personnel involved were I.D. Bishop, B.H. Dolan, and G.R. Pettifer (Geophysicists), S. Hall (shooter), and field assistants from the contractors Rankine and Hill Ltd and BMR.

2. GEOLOGY

The Deakin Fault extends through the western part of the survey area. West of this line, outcrop is of Mount Painter Porphyry, a dark, massive porphyritic dacite to rhyodacite of Upper Silurian age. Older rock is exposed to the east. The Black Mountain Sandstone, the State Circle Shale (Lower Silurian), and the Pittman Formation (Upper Ordovican) form the sequence on the side of the mountain and the peninsula. Recent alluvium overlies this material at the eastern edge of the survey area. Strusz & Henderson (1971) give further details.

3. METHOD AND EQUIPMENT

On land, the subsurface investigation was carried out using the seismic refraction method (Dobrin, 1952) with standard BMR refraction equipment consisting of a 24-channel SIE seismograph and 20 Hz TIC geophones.

Geophone spacings of 3 m were used for all traverses except 6B where 4-m spacings were used. Generally, reciprocal geophones were used and shots were fired at the centre, at the ends, and at about 50 m from the ends on each spread. The proximity of the lake sometimes prevented this pattern being followed.

Interpretation was by the time-intercept method (Dobrin, 1952), and the reciprocal method (Hawkins, 1961).

On the water, a BMR-modified E.G. & G Sonar Boomer system and a Raytheon 3.5 KHz transducer were used to obtain seismic reflection profiles of shallow sub-bottom features.

4. RESULTS

The layout of the seismic traverses is shown in Plate 1 and the sections obtained from seismic interpretation are shown in Plates 2 to 4.

The seismic velocities may be divided into 3 principal categories:

(1) 300-600 m/s unsaturated soil. This layer is generally thin (1-4 m).

(2) 700-1900 m/s. This category is more complex and includes scree material (velocity increasing with the size of rock fragments), weathered, and very fractured bedrock. The velocity of scree material tends towards the higher end of the range with increasing water content. Maximum thickness is 22 m.

(3) 2100-4800 m/s. Moderately weathered and jointed bedrock to fresh bedrock. The velocity increasing as the joints become more closed.

In order to divide category (2) into its geological units, sampling by drill cores would be necessary. Some of this zone would require blasting specifically those with velocities in excess of about 1500 m/s if this is in situ weathered bedrock (Caterpillar Tractor Company, 1966).

In most of the area surveyed the thickness of the material overlying bedrock is 7 m or less. There are three regions of considerable thickening. About 50 m from the north end of Traverse 1 the overburden thickness increases to about 22 m. The average thickness on Traverse 7 is 13 m and on Traverse 8 it is 15 m.

The seismic velocities indicate that the bedrock east of the Deakin Fault is very jointed. Sonic velocities were measured on core samples by Dr. M. Idnurm in the BMR Rock Testing Laboratory. The velocity of the rock pieces in the horizontal direction was an average of 3260 m/s at a depth of 8 m near Traverse 3. The in situ velocity of the rock mass was 2500 m/s at the same depth. This velocity difference would indicate that the rock is very jointed.

On two traverses a deeper refrator of higher velocity was recorded. On Traverse 6B a deeper refractor of velocity 3000 m/s was recorded at a depth of about 42 m. On Traverse 11 a deep refrator of velocity 4800 was recorded at a depth of 60 m below the lake bottom. If this refractor is jointed bedrock, then the joints are closed. The geological map shows two faults in the area (Plate 1). Evidence of these faults can be seen in the seismic cross-sections.

The Deakin fault is clearly indicated in Traverse 7 where the bedrock velocity changes from 2500 m/s to 3200 m/s with a low velocity zone of 1800 m/s in between. A possible fault is indicated about 90 m from the northwest end of Traverse 3.

The 'Sonar Boomer' and Raytheon 'Pinger' were used to obtain a reflection profile of the lake bottom. A 12-channel floating hydrophone array and an R.S.4 S.I.E. Seismic refraction recorder were used to obtain a refraction profile. The Traverses surveyed (10 & 11) are shown in Figure 12.

The reflection profiles yielded only reflections from the bottom of the lake over most of the profile length. At two locations where the depth of water was 15 m another reflector was recorded. This indicated a thickness of unconsolidated sediment in deep parts of the lake. A maximum thickness of 1 m was recorded. A thickness of up to 4 m has been recorded in parts of the lake outside the survey area. The depth of water in these areas was also about 15 m.

5. CONCLUSIONS

The overburden, much of which would be scree material, reaches its greatest thicknesses on Traverses 7,8,9, and part of 1. The bedrock east of the Deakin Fault is fractured to depth below surface of up to 50 m.

6. REFERENCES

CATERPILLAR TRACTOR COMPANY, 1966, - HANDBOOK OF RIPPING.

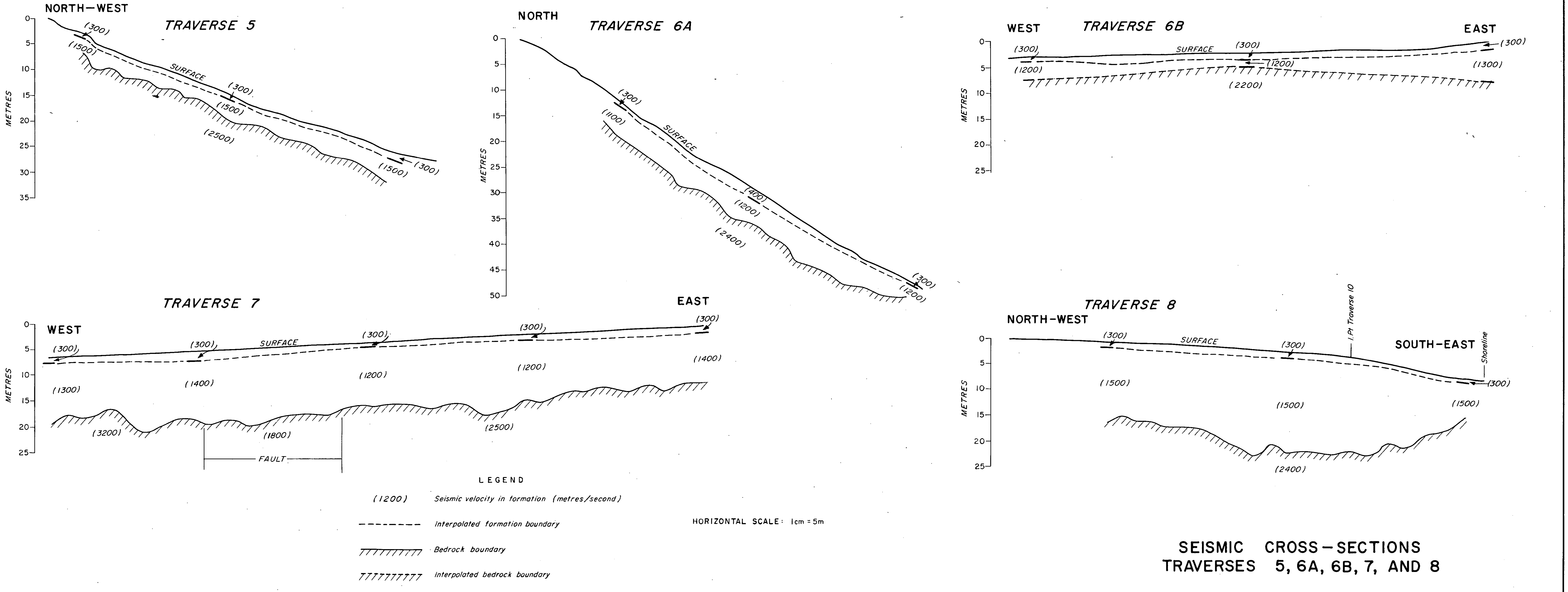
DOBRIN, M.B., 1952 - INTRODUCTION TO GEOPHYSICAL PROSPECTING. N.Y., McGraw-Hill.

HAWKINS, L.V., 1961 - The reciprocal method of routine shallow seismic refraction investigations. Geophysics, 26(6), 806-19.

STRUSZ, D.L., & HENDERSON, G.A.M., 1971 - Canberra City, A.C.T. 1:50,000 Geological Map. Bur. Miner. Resour. Aust. explan. Notes.

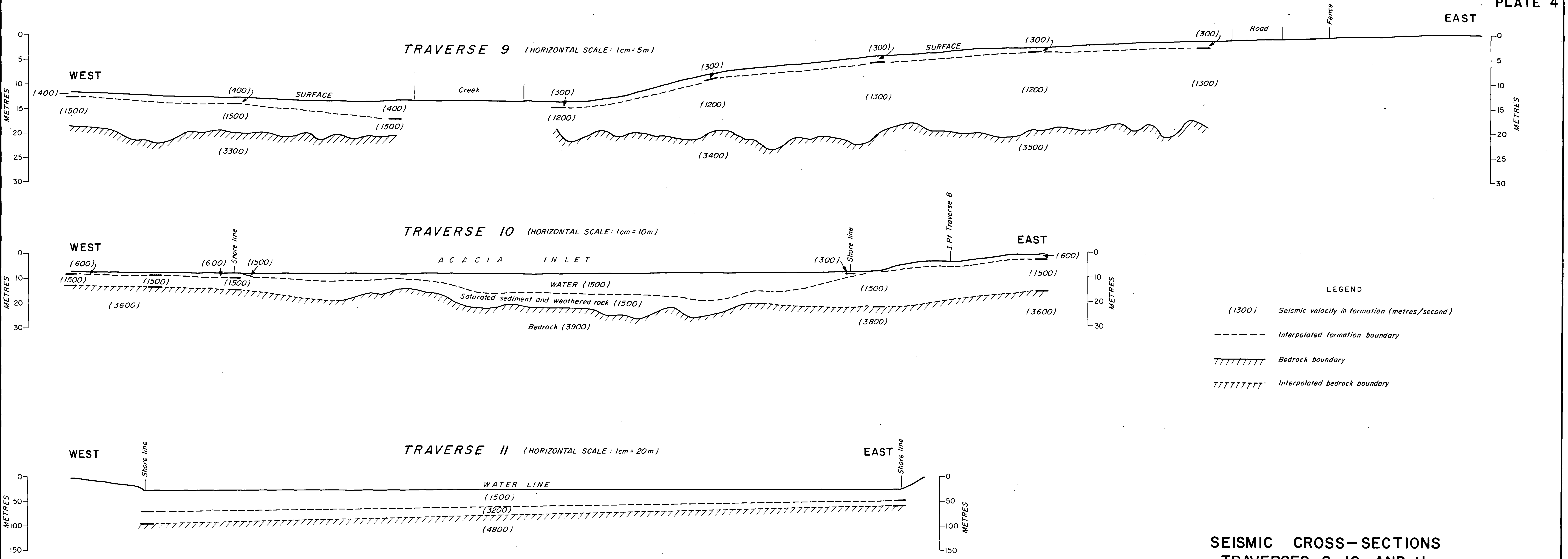

PLATE I
TRAVERSE 1
TRAVERSE 2
TRAVERSE 3
TRAVERSE 4
TRAVERSE 5
TRAVERSE 6A
TRAVERSE 6B
TRAVERSE 7
TRAVERSE 8
TRAVERSE 9
TRAVERSE 10
TRAVERSE 11
BLACK MOUNTAIN FAULT
DEAKIN FAULT
LADY DENMAN DRIVE
CLUNIES ROSS ST
△ Sullivan
ACACIA INLET
LAKE BURLEY GRIFFIN
Kurrajong Point
WESTON PARK
TARCOOLA REACH
BLACK MOUNTAIN PENINSULA
WEST LAKE
12000 N
11000 N
23000 E
24000
25000
26000
27000
28000
29000 E
100 0 100 200 METRES
100 0 200 400 600 800 1000 FEET
CO-ORDINATES ARE IN FEET WITH ORIGIN AT STROM TRIG. STATION
LEGEND
Seismic traverse
1900 Elevation contour (feet)
Road
Minor road or track
Stream
Fence
Fault
LOCALITY MAP
SURVEY AREA
CANBERRA
CITY
COMMONWEALTH AVENUE
LAKE BURLEY GRIFFIN
CAPITAL HILL
TUGGERANONG FREEWAY
TRAVERSE PLAN AND
LOCALITY MAP
To accompany Record No. 1973/9
I55/B5-183

SEISMIC CROSS—SECTIONS
TRAVERSES 1, 2, 3, AND 4



SEISMIC CROSS-SECTIONS
TRAVERSES 5, 6A, 6B, 7, AND 8

PLATE 4



SEISMIC CROSS-SECTIONS
TRAVERSES 9, 10, AND 11

To accompany Record No. 1973/9

I55/B5-186