DEPARTMENT OF
MINERALS AND ENERGY

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD 1975/76

MOLONGLO PARKWAY, BLACK MOUNTAIN, A.C.T.:
ADDITIONAL SEISMIC SURVEY, 1974

by

D.C. RAMSAY

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PLATES

SUMMARY

Further seismic refraction investigations were carried out at selected locations along the route of the proposed Molonglo Parkway, near Black Mountain, A.C.T. The aim of the survey was to determine subsurface conditions in areas of proposed major road-cuttings.

The depth of overburden ranges from 1 m to 24 m, with an average value of about 7 m; the scree component will be easily removed, but some of the in situ weathered bedrock will require blasting. The average bedrock velocity is about 2700 m/s, indicating that it is generally moderately jointed or fractured.

1. INTRODUCTION

The proposed Molonglo Parkway forms part of the transport system planned by the National Capital Development Commission (NCDC) for the rapidly growing urban complex of Canberra. Part of this proposed parkway runs along the southern slopes of Black Mountain close to the edge of Lake Burley Griffin (Plate 1). Construction will involve two substantial road excavations, one in the Acacia Inlet area and the other, the deeper and longer of the two, across Black Mountain Peninsula.

To assist with the planning and construction of the roadworks, the Bureau of Mineral Resources, Geology and Geophysics (BMR) was asked to investigate the geology along the proposed route. Working in conjunction with the BMR Engineering Geology Section, a seismic refraction survey was carried out at selected locations to determine underground conditions such as depth to bed-rock, nature of overburden and rippability. The fieldwork was carried out in August 1974 by parties from the Engineering Geophysics Group, drawn from M.I. McDowell, F.N. Michail, D.C. Ramsay (geophysicists), and field hands from the Engineering Geology Section.

Previous seismic work was done along the proposed route (Bishop & Dolan, 1973) at locations shown in plate 1.

In this Record the term 'bedrock' is defined as the deepest refractor detected, and the term 'overburden' as soil, scree, and weathered rock above this refractor.

2. GEOLOGY

The detailed geology is described in a report by Purcell & Goldsmith, Rec. 1975/46.

In the area of Acacia Inlet the proposed parkway will probably be excavated in scree, which is a result of slopewash movement from the higher slopes of Black Mountain and is composed of Black Mountain Sandstone fragments in a clay matrix. The Deakin Fault crosses this area of cut, and separates the sedimentary rocks to the east from Mount Painter Porphry to the west. Excavation across Black Mountain Peninsula will be through State Circle Shale, mudstone, slopewash, and isolated areas of river gravel. Several minor faults are known to cross the proposed parkway in this area.

3. METHOD AND EQUIPMENT

Subsurface conditions were investigated by the seismic refraction method, as outlined in Dobrin (1952). Depths to refracting layers were calculated from intercept times on the normal time-distance plots, along with a modification of the reciprocal method (Hawkins, 1961).

Geophone spacings of 3 m were used throughout the survey, each spread consisting of 23 geophones with a 24th as the reciprocal. Five shots per spread were fired: in the centre, at 1 m beyond either end, and between 30 and 40 m beyond either end. Fourteen spreads were recorded at various locations, giving a total of about 970 m of seismic coverage.

BMR's 24-channel SIE PSU-19 refraction equipment with 8Hz GSC-20D geophones were used.

4. RESULTS

The results of interpretation are presented as seismic cross-sections in Plates 2 to 5.

Three broad groups of velocities were recognized:

(1) 300-600 m/s. This layer is interpreted as surface soil and fine slope-wash material, and is typically about 1 m thick. It reaches a maximum thickness of about 4 m on spread 10.

(2) 900-2300 m/s. This intermediate layer is interpreted as scree, along with in situ rock varying from highly weathered to moderately to slightly weathered. It occurs to a depth of about 7 m on average, thickening on spreads 10, 11, and 12 (traverse 17), and reaches a maximum of about 24 m on spread 10.

(3) 1900-3700 m/s. The bedrock layer is composed of varying rock types interpreted as highly jointed and fractured at the low end of the velocity range to slightly weathered at the high end.

The method of removal of material in group (2) will depend on whether it is scree or in situ weathered rock. The former should all be removable by conventional heavy machinery, whereas weathered rock with a seismic velocity greater than about 1500 m/s would normally require blasting (Caterpillar Tractor Company, 1966). To differentiate between these two possibilities, an auger and diamond-drill survey based on the seismic results was carried out by the BMR Engineering Geology Section (see Purcell & Goldsmith, 1975). In general, the drilling results correlated well with the seismic interpretation, and proved the existence of considerable thicknesses of scree in some places and weathered rock in others. The geological logs are shown along with the seismic cross-sections.

In spread 4, and probably in spread 3, the time-distance curves indicate that seismic velocity increases gradually with depth, rather than in discrete layers. Under these circumstances the depth to the highest velocity encountered cannot be accurately determined, which poses no problem as the velocities indicate that all the material would require blasting before it is removed.

Seismic velocity anisotropy is exhibited where spreads intersect, probably caused by the highly jointed nature of the rock, allowing propagation of seismic energy at a higher velocity along the direction of the joints. This effect may also account for the inexact correlation of refractor depths at spread intersections.

The Deakin Fault is clearly shown in spread 12 (traverse 17), where bedrock velocity is reduced to 1400 m/s flanked on either side by rock with velocity 1900 m/s, which probably represents part of a wide highly fractured zone associated with the fault. Another possible shear zone is shown where spread 7 joins spread 8 (traverse 15).

The results of this survey agree generally very well with the results of the previous seismic work (Bishop & Dolan, 1973).

5. CONCLUSIONS

The excavations across the Acacia Inlet area will probably be through mainly scree, which should be removable without blasting. In the area of Black Mountain Peninsula, the overburden is composed mainly of weathered in situ rock, with evidence of only small amounts of scree; the seismic velocities of this weathered rock suggest that much of it would require blasting before it is removed.

6. REFERENCES

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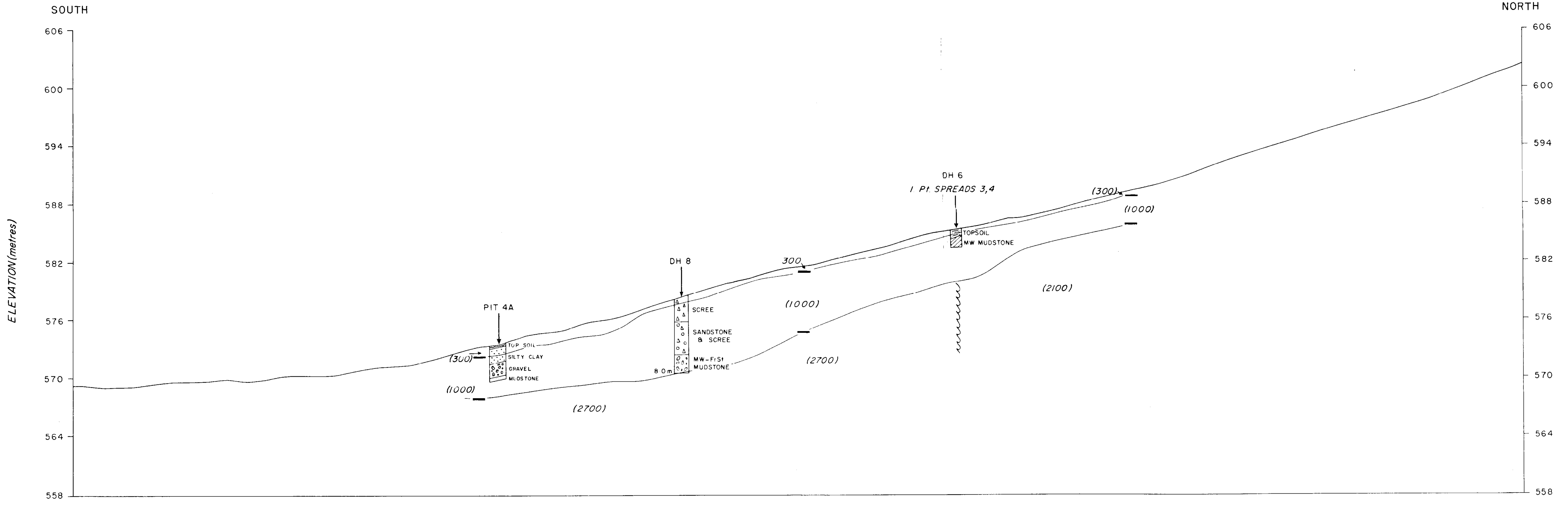
PLATE I
LOCALITY MAP
TRAVERSE 1
TRAVERSE 2
TRAVERSE 3
TRAVERSE 4
TRAVERSE 5
TRAVERSE 6A
TRAVERSE 6B
TRAVERSE 7
TRAVERSE 8
TRAVERSE 9
TRAVERSE 10
TRAVERSE 11
12
TRAVERSE 13
TRAVERSE 14
TRAVERSE 15
TRAVERSE 16
17
18
DEAKIN FAULT
BLACK MOUNTAIN FAULT
LADY DENMAN DRIVE
CLUNIES ROSS ST
Sullivan
ACACIA INLET
LAKE BURLEY GRIFFIN
Kurrajong Point
WESTON PARK
TARCOOLA REACH
BLACK MOUNTAIN PENINSULA
WEST LAKE
LOCATION MAP
SURVEY AREA
CANBERRA CITY
COMMONWEALTH AVENUE
LAKE BURLEY GRIFFIN
CAPITAL HILL
100 0 100 200 METRES
100 0 200 400 600 800 1000 FEET
CO-ORDINATES ARE IN FEET WITH ORIGIN AT STROMLO TRIG. STATION
LEGEND
Seismic traverse (1974)
Seismic traverse (1973)
1900 Elevation contour (feet)
Road
Minor road or track
Stream
Fence
Fault
23 000 E
24 000
25 000
26 000
27 000
28 000
29 000 E
12 000 N
11 000 N
Record No. 1975/76
I 55/B5-183-1

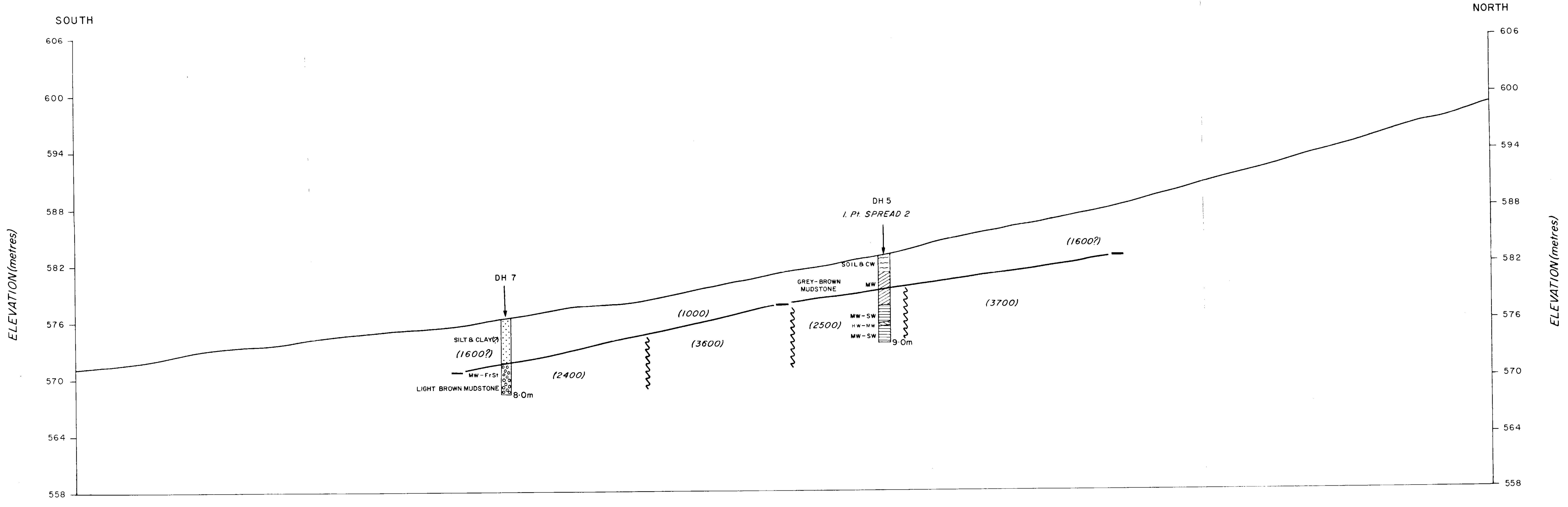
PLATE 2

SEISMIC CROSS-SECTION
TRAVERSE 12

Record No. 1975/76

I55/B5-255





LEGEND

———	FORMATION BOUNDARY	CW	COMPLETELY WEATHERED ROCK
∿∿∿	SEISMIC DISCONTINUITY	HW	HIGHLY WEATHERED ROCK
(300)	SEISMIC VELOCITY IN FORMATION ; m/s	MW	MODERATELY WEATHERED ROCK
I.Pt	INTERSECTION POINT	SW	SLIGHTLY WEATHERED ROCK
		FrSt	FRESH STAINED ROCK
		Fr	FRESH ROCK

5 0 5 10 15 20 25 30 metres

SEISMIC CROSS-SECTIONS
TRAVERSES 13,14

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PLATE 4

LEGEND

— —	INTERPOLATED FORMATION BOUNDARY	HW	HIGHLY WEATHERED ROCK
∿∿	SEISMIC DISCONTINUITY	MW	MODERATELY WEATHERED ROCK
(300)	SEISMIC VELOCITY IN FORMATION (m/s)	SW	SLIGHTLY WEATHERED ROCK
I.Pt.	INTERSECTION POINT	FrSt	FRESH STAINED ROCK
		Fr	FRESH ROCK

5 0 5 10 15 20 25 30 metres

SEISMIC CROSS–SECTIONS
TRAVERSES 15, 16

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PLATE 5
TRAVERSE 17
SPREAD 10
SPREAD 11
SPREAD 12
WEST
EAST
ELEVATION (metres)
CREEK
DH1
PIT 1
DH2
DEAKIN FAULT?
PIT 2
DH3
TOPSOIL
SCREE
MW-HW RHYODACITE
SOIL AND SCREE
RIVER GRAVEL AND SAND
TRAVERSE 18
SPREAD 13
SPREAD 14
DH9
BLUE-GREY MUDSTONE
LEGEND
HW HIGHLY WEATHERED ROCK
MW MODERATELY WEATHERED ROCK
SW SLIGHTLY WEATHERED ROCK
FrSt FRESH STAINED ROCK
FORMATION BOUNDARY
INTERPOLATED FORMATION BOUNDARY
SEISMIC DISCONTINUITY
(300) SEISMIC VELOCITY IN FORMATION (m/s)
SEISMIC CROSS-SECTIONS
TRAVERSES 17, 18
Record No 1975/76
I55/B5-258