DEPARTMENT OF MINERALS AND ENERGY

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record 1973/206

TUGGERANONG FREEWAY, STAGE II SEISMIC REFRACTION SURVEY, A.C.T., 1972

by

M. McDowell

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PLATES

SUMMARY

A seismic refraction survey was carried out on the proposed route of the Tuggeranong Freeway, Stage II. This stage of the freeway extends from Hindmarsh Drive, south to Mount Taylor. The work was done at the request of the National Capital Development Commission (N.C.D.C.) and the aim was to provide the road design contractor with detailed seismic cross-sections in the areas of proposed hill cuttings.

The depth to slightly weathered rock (velocity 2400-3800 m/s) throughout the area is in the range of 20-30 metres which is below the proposed depth of excavation. But moderately weathered rock (velocity 1300-2400 m/s) occurs at depths ranging from 3 to 20 metres below the surface, and some of this will have to be removed at all sections of the proposed road cuttings. Experience shows that this material will require blasting.

1. INTRODUCTION

The proposed Tuggeranong Freeway will run from Scrivener Dam to the proposed urban development area of Tuggeranong. Stage II of the Freeway runs from Hindmarsh Drive to the proposed Village Creek arterial road southwest of Mount Taylor. 830 metres of seismic refraction traversing was done in September 1972 at selected places along the route. The traverses were concentrated around three hilltops in the area where it is proposed to excavate cuttings for the Freeway. The traverses are labelled A, B, C, D, E, F, G and H on the locality map (Plate 1).

Previous seismic work was done along the proposed route by P.J. Hill (1971) as shown in Plate 1. A detailed geological survey including 40 auger holes drilled at appropriate points was made by Vanden Broek & Kellett (1972).

The survey was carried out by officers of the Bureau of Mineral Resources. A list of field personnel and equipment is shown in Appendix A. The interpretation of results was supervised by F.J. Taylor.

2. GEOLOGY

The comprehensive geological survey (Vanden Broek & Kellett, 1972) indicated that there are two main rock types in the area: a blue-grey rhyodacite welded tuff, and a purple spherulitic rhyodacite welded tuff. Sediments do not crop out in the area and it is considered unlikely that they are concealed below soil cover.

Welded tuff when unweathered is very hard and strong. The rock along the freeway has weathered somewhat irregularly to considerable depths; moderate weathering has proceeded to a maximum depth of 30 m, and complete weathering to 10 m.

3. METHOD

The reciprocal method was used in this survey; 23 geophones were used on the main spread line with a 24th geophone as the reciprocal.

A 2-metre spacing was used between geophones on all spreads. Seven shots were recorded on each spread, with the shots positioned as follows:

A shot at a distance of 1 metre from each end of the spread; one shot each between the 6th and 7th, the 12th and 13th, and the 18th and 19th geophones; and a long shot fired at a distance of 23 metres beyond each end of the spread.

This particular configuration of 5 close-spaced shots along the main spread line was chosen so as to reveal any near-surface lateral changes in velocity.

4. RESULTS

Four groups of velocities were observed, and are interpreted as follows:

300 - 400 m/s - surface soil

700 -1200 m/s - highly weathered volcanic rock

1300 -2400 m/s - moderately weathered volcanic rock

2500 -3800 m/s - lightly weathered volcanic rock.

Seismic velocities and the depths at which they occur should give a reliable indication of the type of excavation technique in a particular area (Caterpillar, 1966). Materials with a seismic velocity up to 900 m/s can be moved by a tractor-mounted scraper, blade, or shovel. Layers with seismic velocities up to 1500 m/s can be ripped by D7 or D8 tractors fitted with hydraulic rippers. Any material with seismic velocities above 1500 m/s will normally need to be blasted. In areas where high-velocity 'floaters' are likely to occur, excavation may be more difficult and velocities of about 1300 m/s may require some blasting.

Cross-sections of the traverses are shown in Plates 2 and 3 together with the proposed depths of cut. The depth to bedrock throughout the area is between 20 and 30 metres, which is below the proposed depth of excavation for the freeway. For practical purposes the region shown as the third layer with velocities generally ranging from 1300-2400 m/s and containing some material of anomalously high velocity (e.g. 3800 m/s at 15 520 m, Traverse G) will require light to heavy blasting before removal. The material above this third layer will be rippable by conventional heavy machinery.

5. CONCLUSIONS

All three areas of cut will require some blasting of the moderately weathered layer. An estimate of the amount of blasting necessary is given by the following figures. In the area of Traverse A nil, Traverse B 50%, Traverse C 60%, Traverse D 15%, Traverse E 40%, Traverse F 25%, Traverse H 60%, will have to be blasted. These are rough figures based on proposed depths of cut shown in Geological drawing No. I55/A16/867 (BMR).

6. REFERENCES

CATERPILLAR TRACTOR CO. 1966 - Handbook on ripping.

HILL, P.J., 1971 - Seismic refraction survey along Tuggeranong Freeway Stage II and Village Creek Arterials, A.C.T., 1971. Bur. Miner. Resour. Aust. Rec. 1972/84 (unpubl.).

VANDEN BROEK, P.H. & KELLETT, J.R., 1972 - Geological, seismic and soils evaluation of the route proposed for the Tuggeranong Freeway, Stage II, A.C.T. Bur. Miner. Resour. Aust. Rec. 1972/73 (unpubl.).

APPENDIX A

The field personnel involved in this survey were:

B.H. Dolan	Party Leader
M.I. McDowell	Geophysicist
S.J. Hall	Field Hand (Shooter)
D. Tarlington	Trainee Technical Officer
M. Smith	Trainee Technical Officer
C. Rochford	Trainee Technical Officer

The equipment used was:

Amplifiers:	S.I.E. - PSU19 24-channel refraction amplifiers
Camera:	S.I.E. - PRO11 25-channel oscillograph
Geophones:	T.I.C. 20-Hz H.S.J. 14-Hz
Vehicles:	1 Land Rover 1 International recording cab.

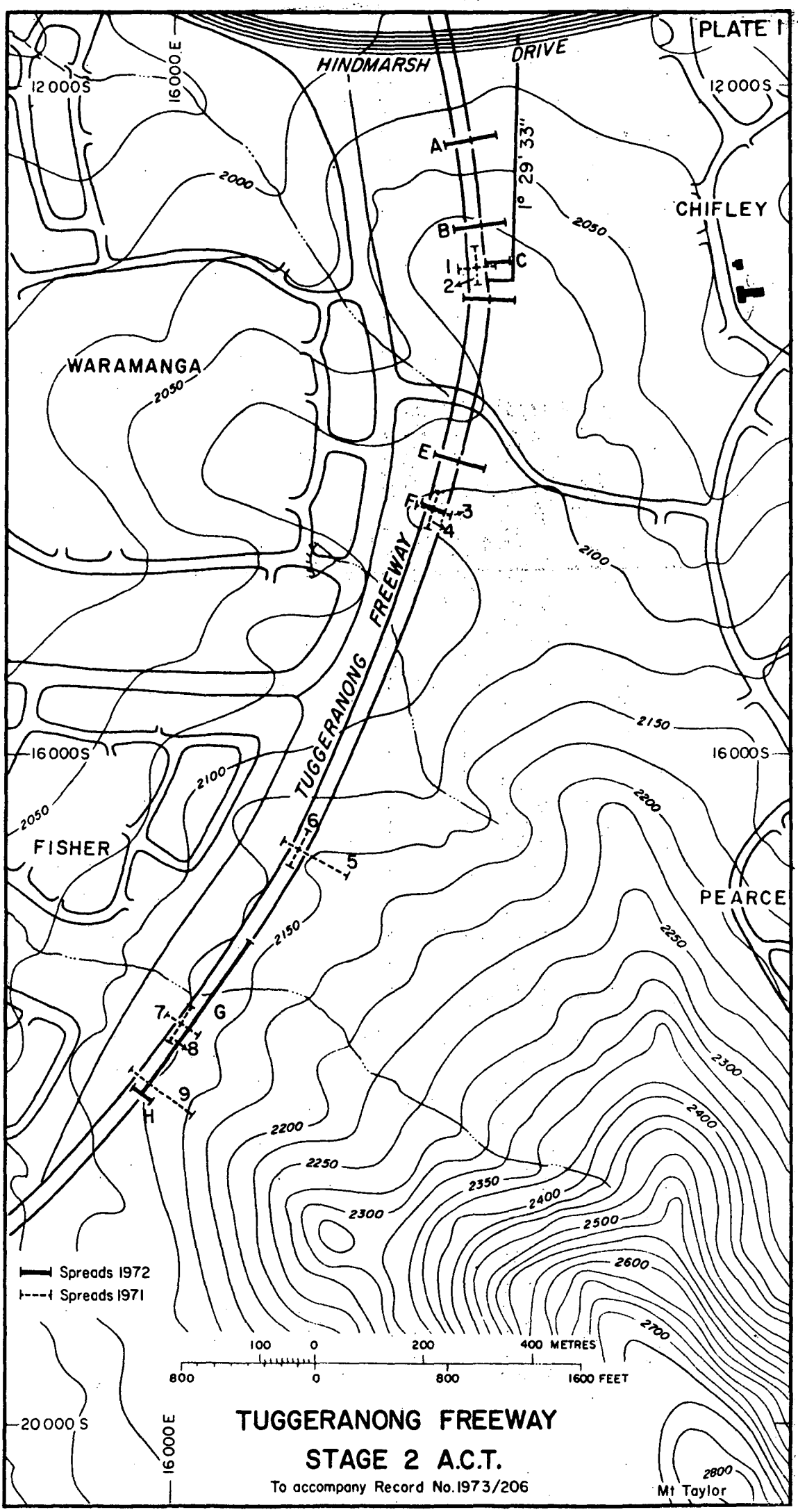
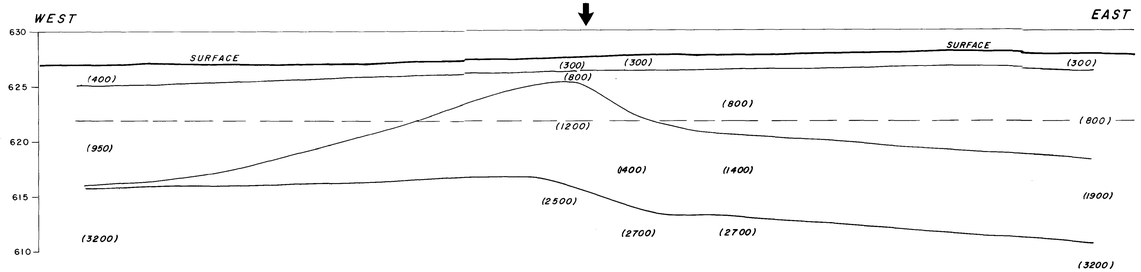
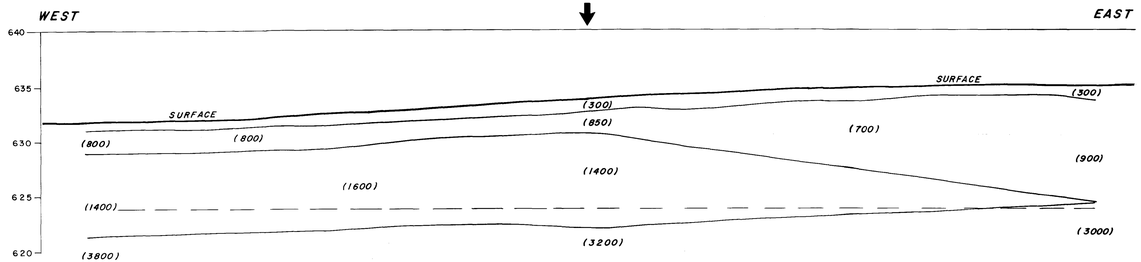


PLATE 1
HINDMARSH
DRIVE
12 000 S
16 000 E
1° 29' 33"
CHIFLEY
WARAMANGA
TUGGERANONG FREEWAY
FISHER
PEARCE
16 000 S
20 000 S
2000
2050
2100
2150
2200
2250
2300
2350
2400
2500
2600
2700
2800
A
B
C
E
F
G
H
1
2
3
4
5
6
7
8
9
Spreads 1972
Spreads 1971
100 0 200 400 METRES
800 0 800 1600 FEET
TUGGERANONG FREEWAY
STAGE 2 A.C.T.
To accompany Record No. 1973/206
Mt Taylor

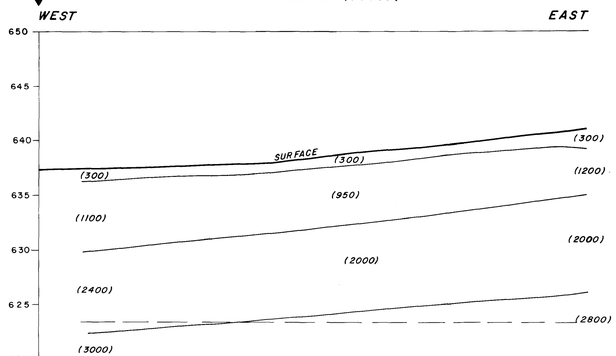
TRAVERSE A (13870)



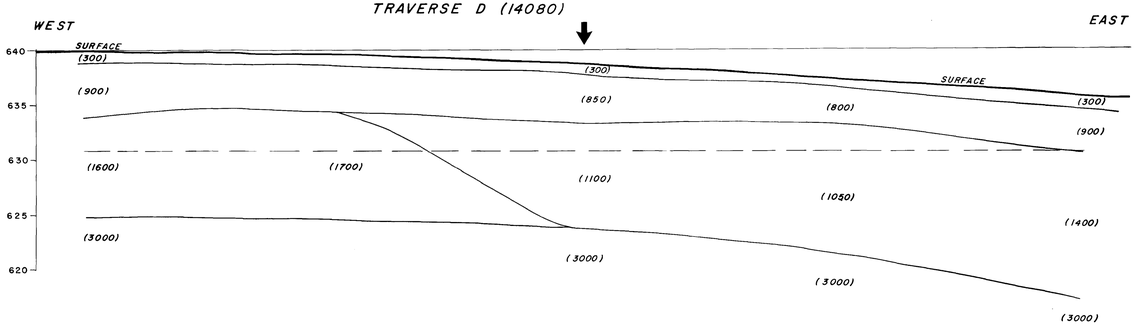
TRAVERSE B (13940)



TRAVERSE C (14010)



TRAVERSE D (14080)



LEGEND

- Eastern edge of proposed freeway
- Interpolated boundary
- (3000) Seismic velocity in formation (m/s)
- — — — Approximate depth of cut

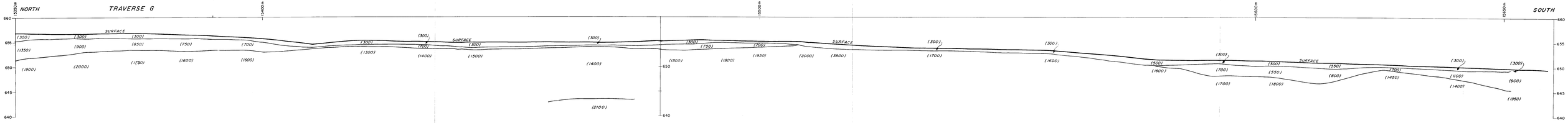
HORIZONTAL AND VERTICAL SCALE

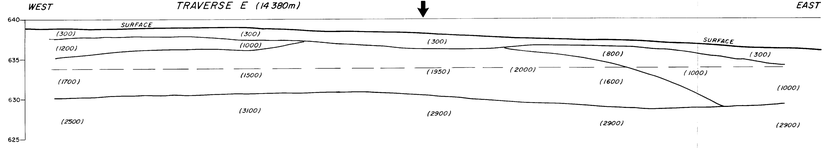
10 0 10 20 METRES

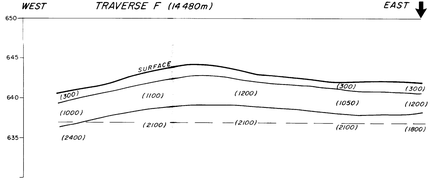
Heights are in metres, based on Canberra city datum

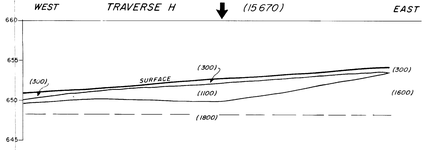
CROSS-SECTION TRAVERSES A, B, C AND D

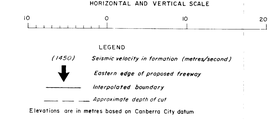
To accompany Record No. 1973/206











CROSS-SECTION
TRAVERSES E,F,G AND H

To accompany Record No. 1973/206