COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record No. 1971/15

Barton (Section 4) Seismic Refraction Survey, A.C.T., 1970

by

P. J. Hill

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ILLUSTRATIONS

SUMMARY

In response to a request by the National Capital Development Commission the Bureau of Mineral Resources, Geology & Geophysics (BMR) conducted a seismic refraction survey at the site chosen for the construction of the Trade Group Offices at Barton, A.C.T.. The survey was done to assist foundation planning by providing subsurface information such as overburden thickness and nature of the bedrock.

The results of the survey indicate that the bedrock consists of rock with a seismic velocity from 5800 to 7200 ft/s and that the thickness of the overburden varies from about 10 to 35 feet along the traverses. By correlation with drilling results it appears that the bedrock is of medium hard shale and that the overburden is composed mainly of clay (often containing bands of shale) and clayey shale.

The fact that only comparatively low velocity rock was encountered suggests that the bearing strength of the beds may be low.

1. INTRODUCTION

The National Capital Development Commission proposes the building of the Trade Group Offices on Section 4 at Barton, A.C.T.. To provide preliminary information on foundation conditions at the site the Commission requested BMR to conduct a seismic refraction survey. A geophysical party consisting of E.J. Polak and P.J. Hill (geophysicists), D. Tarlinton (technical assistant), R. Cherry (shooter) and two field assistants provided by the Department of Works conducted the survey during March 1970. Interpretation was done by B. Dolan (geophysicist).

Diamond core drilling was done on the site at the conclusion of the survey and the geological sections were compared with the seismic refraction results.

2. GEOLOGY

The geology of the area is described by Gardner (1969) and Purcell (1970). The bedrock at the site is part of the Riverside Formation (Lower Silurian) and is thought to consist of calcareous shale, sandstone, and lenticular limestone. Trenches in the northern part of Section 4 were mapped by Thieme (1969) and revealed hard, moderately weathered siltstone

below about a five-foot cover of soil. The strike of the jointing was found to be variable and the dips mainly 80° to 90° In the central area of Canberra weathering of the rocks below the surface generally extends to great depths, and this is expected at the site. The existence of limestone could cause foundation problems as it did at the Secretariat Building site (Best & Henderson, 1968) owing to the formation of cavities by groundwater solution.

The tectonic map of Canberra by Öpik shows no faults crossing the site. The nearest major feature is the Acton Fault which runs about 200 ft west of the site. A minor fault is indicated about 600 ft to the north.

At the completion of the seismic survey forty-four test bores were drilled ranging in depth from 25 to 160 feet. Generally clay or shales were encountered; however, at the western margin of the site a large limestone deposit was found. This limestone, which is overlain by the clay and shales, contains cavities and rises to within 20 ft of the surface; it attains depths in excess of 160 ft. The shallowest cavity in a bore was found at 62 ft. The nature of the subsurface appears to be very variable and consists mainly of zones of clay and shale. No definite horizons are apparent, and the hardness of the shales does not always increase with depth; regions of clay and shaley clay occur at depths greater than 50 ft.

3. EQUIPMENT AND METHOD

Standard BMR 24-channel refraction equipment was used (SIE seismograph and 20-Hz TIC geophones). Nine spreads were laid along two intersecting traverses with geophone spacing of 5 ft; five shots were fired on each spread, and in general shots were fired at the centre and at 2½ ft and 117½ ft from each end.

A modification of the "method of differences" (Heiland, 1946) was used in the interpretation of field data.

4. RESULTS

Plate 1 shows the location of the two traverses, and the seismic cross-sections along these traverses are shown in Plate 2. Results of test bores, which were drilled within 15 ft of the traverses, are also shown in Plate 2 to allow correlation between refractor and actual rock. No elevation measurements were made along the traverses as the site was very flat with only a gentle slope; the maximum gradient occurs along Traverse 1, the elevation uniformly increasing from west to east by only about 10 ft. Thus the surface in the section is shown as a

horizontal line, the resultant error in the depth being negligible, and even for the deepest refractor a horizontal displacement of less than one foot is involved.

The subsurface along the traverses is interpreted as being divided into three main velocity strata:

(1) A top layer having a velocity of about 1500 ft/s

(2) An intermediate layer of velocity 3600 to 5200 ft/s, the depth of which is fairly constant and averages about 8 ft.

(3) A lower layer varying in velocity from 5800 to 7200 ft/s and lying at a depth ranging from about 10 to 35 ft.

The interpretation of the nature of these layers is assisted by the results of the core drilling. The top layer appears to consist of soil and relatively dry clays, and the intermediate layer mainly of hard clays containing shale bands; zones of clayey shale also occur. The lower layer is apparently medium hard shale. The extent of this layer could not be determined from the seismic results as this layer had the highest velocity recorded. The layer could be underlain by lower-velocity material such as clay or soft shale. The limestone below the shale at the western end of Traverse 1 was not detected, probably because of its depth and also because its seismic velocity may be less than or not appreciably greater than that of the shale.

In general there is good correlation of the seismic results with the geological section obtained by drilling. Of the four bores drilled near the traverses, three showed that the calculated depth to bedrock (defined in this Record as the deepest refractor with the highest seismic velocity) agreed to better than 5 ft with the top of the first layer of medium hard shales. In the fourth near the intersection of the traverses the bedrock coincides with the middle of a layer consisting of shale and clayey shale, which are soft and occasionally medium hard.

5. CONCLUSIONS

The seismic survey showed that the bedrock at the site was of low velocity, and from the drilling it appears to consist of medium hard shale. The drilling results also indicate that the subsurface is heterogeneous with zones of clay and shale in various conditions occurring at depths in excess of 100 ft; on the western side of the site, cavernous limestone exists.

Load tests at the site are suggested, to determine any weakness in the foundation material which could lead to excessive settlement or differential settlement. More deep drilling to about 100 ft would be desirable near the centre of the site to determine the extent of the limestone deposit.

6. REFERENCES

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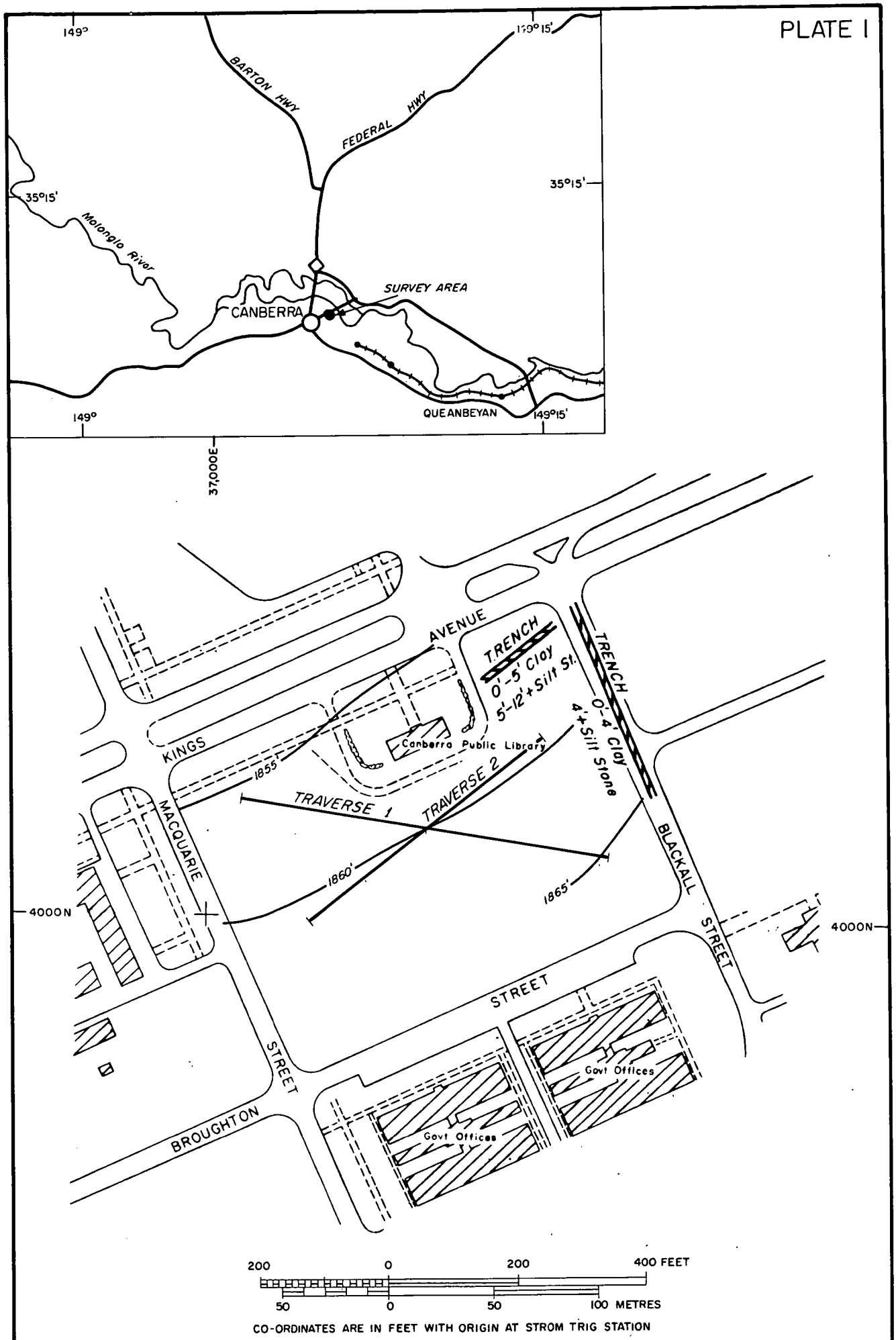
PLATE I



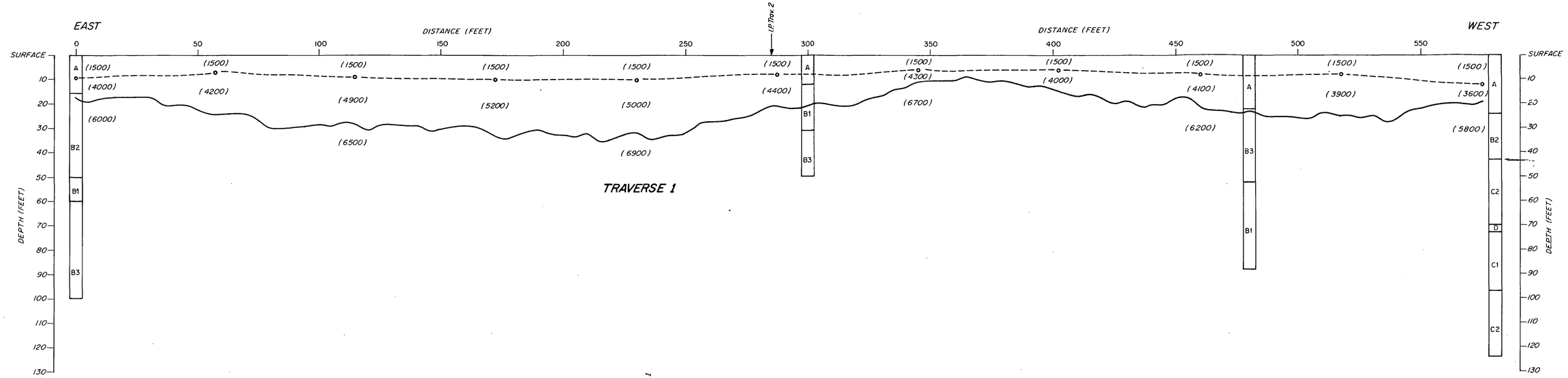
CO-ORDINATES ARE IN FEET WITH ORIGIN AT STROM TRIG STATION

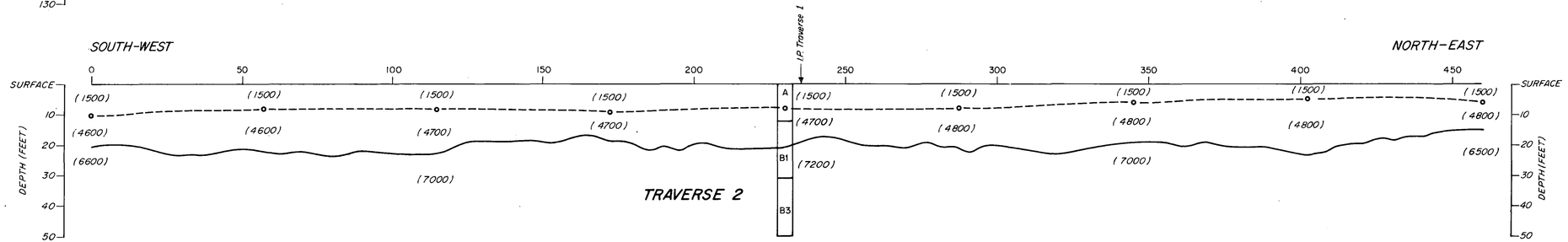
BARTON OFFICES ACT 1970

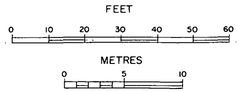
LOCALITY MAP AND TRAVERSE PLAN

TO ACCOMPANY RECORD NO 1971/15

I55/B5-87A







(7200)	Seismic velocity (ft/s)	A	Topsoil, clay and shaley clay	C1	Limestone, hard but fractured
I.P.	Intersection point	B1	Clayey shales and shale	C2	Limestone, hard and sound
------	Interpolated boundary	B2	Shales, medium hard but fractured	D	Cavity
———	Bedrock boundary	B3	Shales, medium hard to hard and sound		

SEISMIC CROSS-SECTIONS

TO ACCOMPANY RECORD NO 1971/15

I55/B5-88

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