DEPARTMENT OF NATIONAL RESOURCES

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record 1977/22

DEFENCE FORCE ACADEMY SITE, DUNTROON ACT: ADDITIONAL SEISMIC SURVEY, MARCH 1977

by

D. G. Bennett

Record 1977/22

DEFENCE FORCE ACADEMY SITE, DUNTROON ACT: ADDITIONAL SEISMIC SURVEY, MARCH 1977

by

D. G. Bennett

CONTENTS

SUMMARY

The Bureau of Mineral Resources, Geology & Geophysics carried out further seismic refraction investigations over part of the Australian Defence Force Academy site, Duntroon, ACT. The investigated area is underlain by dacite, rhyolite, and ashstone. The seismic results show generally a four-layer profile with the two surface layers being rippable. Depths of rippable material range from less than 1 m to 5 m. Changes in rock type and other shear zones were noted on the seismic sections.

INTRODUCTION

As requested by the Department of Construction, the Bureau of Mineral Resources, Geology & Geophysics (BMR) carried out a seismic survey along three traverse lines on the site of the proposed Australian Defence Force Academy. Previous geological and geophysical investigations at the site are presented in BMR Record 1976/71 by Bennett and Jacobson. The geological data presented in that Record cover the area investigated by these three seismic traverses (Pl. 1). The reader is also referred to that Record for discussion on the seismic method, equipment, and relation between seismic velocities and excavation conditions (Table 1).

Field work was carried out between 10 and 22 March 1977. All spreads used 2-m spacings except one at the southwestern end of traverse C-D which used 4-m spacing. The field party consisted of D.G. Bennett, E.C. Chudyk, D.H. Francis, M.N. Preston-Stanley, and D.C. Ramsay.

The following table has been used in predicting rippability.

TABLE 1

SEISMIC VELOCITIES AND EXCAVATION CONDITIONS

SEISMIC VELOCITY (m/s)	EXCAVATION CONDITIONS	GEOLOGY
less than 1000	Rippable	Soil; completely to highly weathered rock
1100–1600	Marginal - rip or blast	Highly to moderately weathered rock; possibly corestones of fresher rock.
Greater than 1600	Blasting	Moderately to slightly weathered rock; fresh rock

RESULTS OF SEISMIC SURVEY

The results of the survey are presented as three seismic cross-sections in Figure 2.

Traverse A-B

The seismic section shows essentially a uniform four-layer profile. The surface layer of unconsolidated sediment has a seismic velocity of 300-350 m/s and varies in thickness from 0.7 to 1.4 m. Below this is a layer of saturated soil or extremely to highly weathered rhyolite/ashstone and this has a seismic velocity of 800-1100 m/s. This varies in depth from 1.7 m near the centre of Spread 2 to 5.3 m at the far southwestern end of the traverse. The seismic velocity of these two layers indicates that they should be rippable and the interface between the second and third layers will approximate the depth of ripping. The third layer, probably a moderately weathered rhyolite/ashstone has a seismic velocity of 1800-1900 m/s and varies in depth between 7.2 and 11.1m. Below this is bedrock with a seismic velocity between 3000 and 3600 m/s.

Two features are worth noting on this traverse. One is the bedrock high near the centre of Spread 2, as this will be the highest point of any cut without blasting. The other feature is the shear zone near the centre of Spread 4; it is indicated by a decrease in seismic velocity in all layers (velocities are 600 m/s in a second layer, 1500 m/s in third layer, 2700 m/s in bedrock layer). Part of the third layer may be rippable here.

Traverse C-D

This seismic section is similar to A-B in velocity structure. The surface layer of unconsolidated sediment has a velocity of 300 m/s and is generally less than 1 m thick. However between Spreads 11 and 12 the surface layer thickens considerable to 3 m. Here the seismic traverse passes near the toe of a small embankment dam and this extra thickness of sediment may be due to fill deposited during its construction or natural deposition from the creek. At the centre of Spread 13 a seismic velocity of 650 m/s was noted, although this may be a combination of the top two layers.

Below the surface layer is saturated soil or extremely to highly weathered dacite with a seismic velocity of 1000-1100 m/s . It is thin at the southwestern end, thickens to 4.8 m depth in the centre, and is absent under Spread 11. This will probably represent the limit of ripping. The geological map shows that the boundary between dacite to the south and ashstone to the north passes through Spread 11 and this accounts for the change in seismic properties. The seismic velocity of the slightly weathered layer changes from 1700 m/s in ashstone to 2000-2300 m/s in dacite. The depth to ashstone bedrock (3400 m/s) is relatively shallow (5.5 m) but levels out to 11-14 m in the dacite (3800-4800 m/s). Two possible shear zones were detected, one at the boundary between dacite and ashstone and one near the centre of Spread 13. In both cases the velocity of the third layer decreased to 1500 m/s and bedrock to 2300-2400 m/s. Part of the third layer may be rippable in these places.

Traverse E-F

Again, this seismic section closely resembles the previous two. A thin surface layer of unconsolidated sediment covers the site; it has a seismic velocity of 300 m/s and is 1.2 m at its thickest point. Below this is either saturated soil or extremely to highly weathered dacite with a seismic velocity of 800-1250 m/s. It is thickest near the northeastern end (3.8m), and lenses out near the centre of Spread 9. This interface will probably be the limit of ripping. Geological mapping indicates a faulted contact between dacite to the east and quartz andesite to the west passes near the centre of Spread 9. Seismic evidence of this fault is shown by the lensing out of the second layer, decrease in seismic velocity of third layer, and an increase in the depth to bedrock; however, bedrock velocities remain constant throughout (3500-3700 m/s). The seismic velocity of the third layer varies between 1700 and 2100 m/s and decreases to 1450 m/s at the shear zone. The depth to bedrock varies from 6.6 m at the far southwestern end to 15.6 m near the shear zone. No seismic evidence was found for the change in rock type which, from geological mapping, should pass near the northeastern end of this traverse.

CONCLUSIONS

1. The thickness of rippable material varies from less than 1 m in places where the highly weathered layer is absent, to 5 m at the southwestern end of traverse A-B and the centre of traverse C-D. Depth the bedrock ranges from 6 to 16 m.

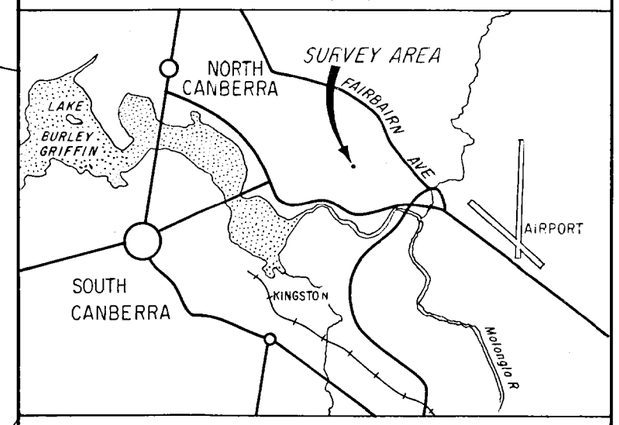
2. Changes in seismic response at the northeastern end of traverse C-D and southwestern end of traverse E-F agree with changes in rock type from geological mapping. Two other shear zones are also indicated.

REFERENCE

BENNETT, D.G., & JACOBSON, G., 1976 - Defence Force Academy site, Duntroon ACT: Investigation of the subsurface, 1975. Bur. Miner. Resour. Aust. Rec. 1976/71 (unpubl.).

PLATE I

LOCATION MAP



NORTHCOTT DRIVE
FAULT
FAULT
620
610
600
590
580
QUARTZ
Pit 4
A
Pit 9
DEEP SOILS (>1·5m) OVERLYING RHYOLITE/ASHSTONE
600
B
590
Pit 1
Trench J8
FAIRBAIRN
AVENUE
Pit 2
E
C
Pit 7
DEEP SOILS (>2m) OVERLYING DACITE
SHALLOW SOILS (<1·5m) OVERLYING DACITE
Pit 6
580
Trench G8
D
POSSIBLE FAULT
Pit 8
Pit 5
600
TRAVERSE 1
TRAVERSE 4
Trench C6/D6
590
Pit 3
Trench D8
TRAVERSE 3
DRIVE
Dacite outcrop
TRAVERSE 2
610
BRIDGES
GENERAL
572
590
580
600

LEGEND

- ROAD
- TRACK
- 580 ELEVATION CONTOUR (2m interval)
- SEISMIC TRAVERSE
- GEOLOGICAL BOUNDARY
- SEISMIC TRAVERSE, MARCH 1977

N

METRES
50 0 50 100

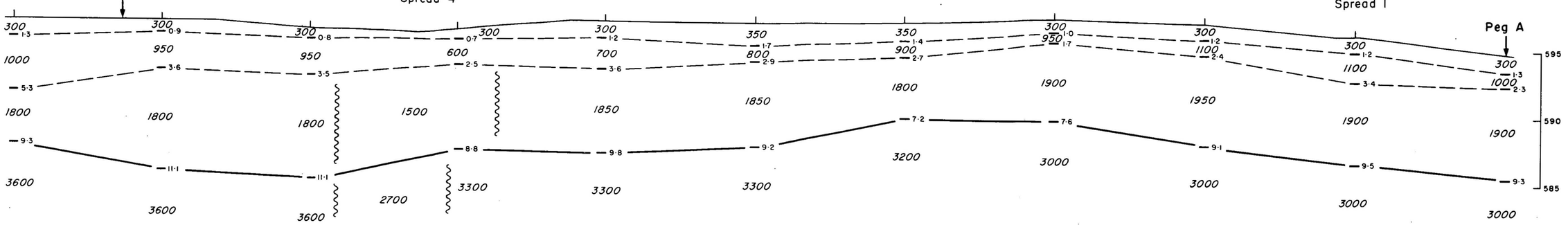
AUSTRALIAN DEFENCE FORCE ACADEMY SITE, LOCATION OF SEISMIC TRAVERSES

Record No. 1976/71 and Record No. 1977/22

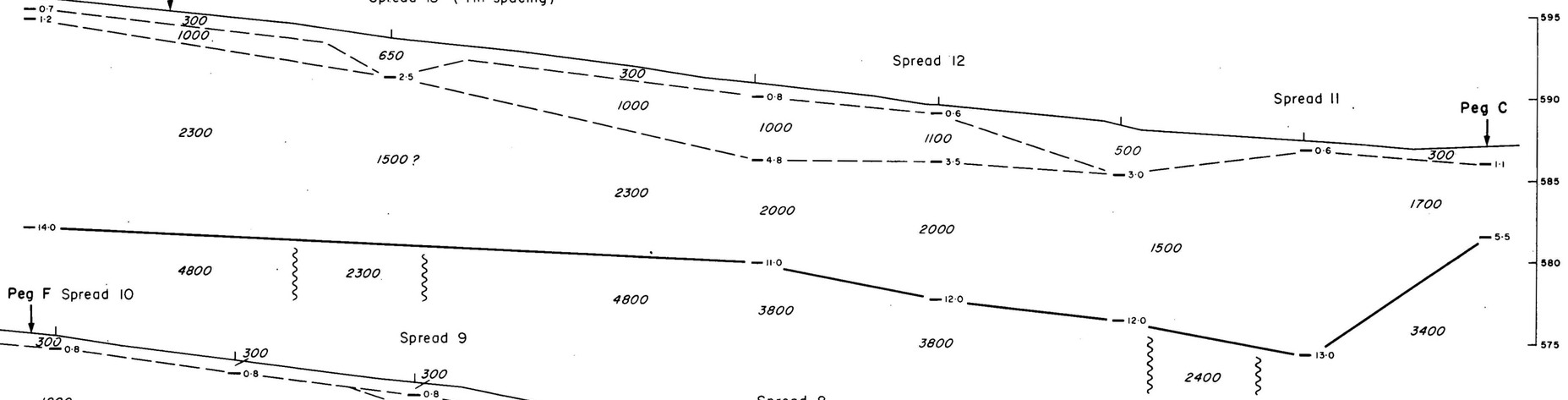
T55/B5-299

PLATE 2

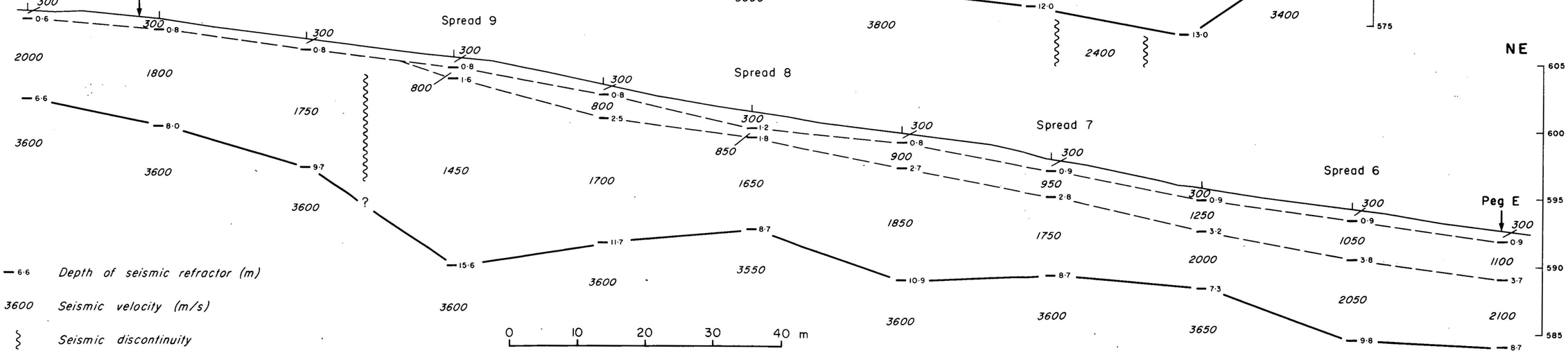
SW — Peg B — Spread 5 — Spread 4 — Spread 3 — Spread 2 — Spread 1 — Peg A — NE



SW — Peg D — Spread 13 (4m spacing) — Spread 12 — Spread 11 — Peg C — NE



SW — Peg F — Spread 10 — Spread 9 — Spread 8 — Spread 7 — Spread 6 — Peg E — NE



6·6 Depth of seismic refractor (m)

3600 Seismic velocity (m/s)

Seismic discontinuity

Interpolated refractor boundary

0 10 20 30 40 m

$\frac{V}{H} = 2$

SEISMIC CROSS-SECTIONS

Record No. 1977/22

155/B5-367