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DEPARTMENT OF
NATIONAL DEVELOPMENT

BUREAU OF MINERAL
RESOURCES, GEOLOGY
AND GEOPHYSICS

Record 1972/8

BELCONNEN REFUSE DISPOSAL AREA SEISMIC REFRACTION SURVEY, A.C.T. 1971

by

P.J. Hill

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ILLUSTRATIONS

SUMMARY

The Bureau of Mineral Resources, Geology and Geophysics conducted a seismic refraction investigation on an 185 acre site in Belconnen, A.C.T., to assess its suitability as a district refuse disposal area.

It was found that over the site (except for three relatively small areas of rock outcrop) the average depth of rippable overburden is about 30 feet. Except for the low-lying central area of the site, where there could be a danger of groundwater pollution, the greater part of the site is suitable for landfill refuse disposal.

INTRODUCTION

The Department of Interior through the National Capital Development Commission plans to establish a new district refuse disposal area for Canberra on Block 105 Belconnen. The site which covers an area of about 185 acres is to be worked by a landfill-type disposal method and may be retained permanently for refuse disposal.

In the present-day landfill method which is widely employed (Wylie, 1968) garbage material is covered daily by a thin layer of soil after compaction by heavy tractor machinery; when landfill is completed a final cover of soil at least 2 feet deep is spread over the various layers of refuse beneath. To obtain sufficient trench depth and cover material it is estimated that a thickness of at least 7 feet of soil or soft rippable material is required over most of the site.

The Bureau of Mineral Resources, Geology and Geophysics was asked to assess the suitability of the site and as part of this investigation the Engineering Geophysics Group of the Bureau conducted a seismic refraction survey at the site to determine depth of rippable material and depth to bedrock, the latter being of assistance in groundwater study.

The seismic survey was carried out in April 1971, by a party consisting of P.J. Hill (geophysicist and party leader), G. Pettifer (geophysicist), S. Hall (shooter), and two field assistants.

The location of the proposed disposal area and a site plan showing the positions of the seismic traverses is shown in Plate 1.

GEOLOGY

A geological record on the area is in preparation (Van den Broek) and the geological outline given below is from discussion with the author of this Record.

The site lies in an area consisting mainly of acid volcanics which belong to the Deakin Volcanics formation. Although the site is mostly soil-covered, outcrops occur in three areas and are shown in Plate 1. In the central northern section a bouldery outcrop of rhyodacite welded tuff is present; at the mid-western margin there is a small bedded tuff and mudstone outcrop; and in the southwest corner massive outcrops of recrystallized rhyodacite porphyry occur (Van den Broek, in prep.).

Augering done on the site has shown that the typical sequence of subsurface layering consists of 1 foot of topsoil, followed by about a 6-foot thickness of clay, which in turn is underlain by highly to completely weathered volcanics over most of the site, except the low-lying central section. Here tuffaceous sedimentary rock underlies the clay and in contrast to the weathered volcanics it was found difficult to penetrate with the mechanical auger used.

Although there is no surface evidence of groundwater flow on the site, there is a large seepage area in the creek just south of the 'Belconnen' homestead which provides a substantial permanent flow. Outcrops of tuffaceous mudstone and sandstone exist in the vicinity of the seepage area and it is believed that it is this relatively impermeable* rock (compared to the weathered volcanics) which has brought the groundwater flows to the surface.

METHOD AND EQUIPMENT

The subsurface conditions at the site were investigated by the seismic refraction method (Dobrin, 1952). Equipment was of standard BMR type, essentially consisting of 24-channel SIE seismograph and 20 Hz TIC geophones.

In order to obtain good coverage of the site a total of eight traverses (A to H) were selected. On each traverse one spread with 10-foot geophone spacing (giving a spread length of 230 feet) was laid and travel times recorded for shots fired 5 and 200 feet beyond the ends and at the centre of each spread.

A modified version of the 'reciprocal method' (Hawkins, 1961) was used in the calculation of refractor depths.

RESULTS

The seismic cross-sections of Traverses A and B, C and D, E and F, G and H are shown in Plates 2, 3, 4, and 5 respectively.

* Permeability tests carried out subsequently by the Petroleum Technology Laboratory gave for weathered volcanics (3 samples) range of permeabilities to nitrogen of 16 to 91 millidarcys and for tuffaceous mudstones (3 samples) range of 0.02 to 0.04 millidarcys. The weathered volcanics indicated permeability to water of 0.25 to 0.58 millidarcys.

A comparison of the results of the seismic work with that of the augering indicates that the seismic velocities of the material penetrated are in the following ranges:

Topsoil	- 1 000 ft/s
Clay	- 1 000 to 3 600 ft/s
Highly to completely weathered bedrock (volcanics)	- 3 100 to 4 200 ft/s

With this information and the results of a seismic survey in a nearby area of similar geology (Hill, 1971), it can be concluded that material at the site with a seismic velocity up to 4 200 ft/s is rippable.

Fresh bedrock on the site appears to have a seismic velocity of between 15 000 and 15 500 ft/s. Where velocities a little lower than this were obtained for the deepest refractor recorded such as 12 800 ft/s on Traverse E, the decrease is believed to be caused by slight weathering of the bedrock. Layers with seismic velocities in the range from about 6 000 to 10 000 ft/s would correspond to fairly hard, moderately weathered rock.

A summary of depth of rippable material and depth to bedrock is given below; a more concise representation is shown in Plate 6, where average values for each traverse are indicated.

Traverse	Position	Depth of Rippable Material (feet)	Bedrock Depth (feet)
A	W end	35	91
	centre	4	101
	E end	39	106
B	NW end	25	74
	Centre	21	74
	SE end	30	72
C	NNW end	15	56
	Centre	17	50
	SSE end	13	53

Traverse	Position	Depth of Rippable Material (feet)	Bedrock Depth (feet)
D	W end	16	42
	Centre	10	46
	E end	15	45
E	NNW end	71	88
	Centre	> 23	94
	SSE end	77	82
F	NNW end	35	83
	Centre	26	65
	SSE end	31	81
G	W end	31	60
	Centre	> 4	88
	E end	37	115
H	SW end	21	68
	Centre	-	64
	NE end	23	61

In the seismic cross-section of Traverse G it can be seen that the bedrock rises quite steeply to the west; it appears on the surface as the outcrop which is about 200 feet west of the traverse.

Consideration must be given to any possible groundwater contamination by waste material to be deposited in the area. The seismic velocity in the weathered rock indicate that none of the weathered material was water-saturated at the time of seismic survey. However, this was during a dry period and conditions may be different following prolonged wet weather. The greater part of the site where the weathered volcanics occur is of high elevation compared to the surrounding land, with bedrock depths generally quite large, averaging about 75 feet. On the basis of these results and assuming that here the water table lies well below the surface the danger of groundwater contamination by contact with buried refuse in these areas of the site would appear to be minimal.

CONCLUSIONS

The survey results indicate that there is adequate depth of rippable overburden on the site for a refuse disposal area. However, except for Traverse D the geophysics was confined to the higher elevations. The low-lying central area involves hydrological considerations beyond the limits of this Record.

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DOBRIN, M.B., 1952 - INTRODUCTION TO GEOPHYSICAL PROSPECTING. New York, McGraw-Hill Inc.

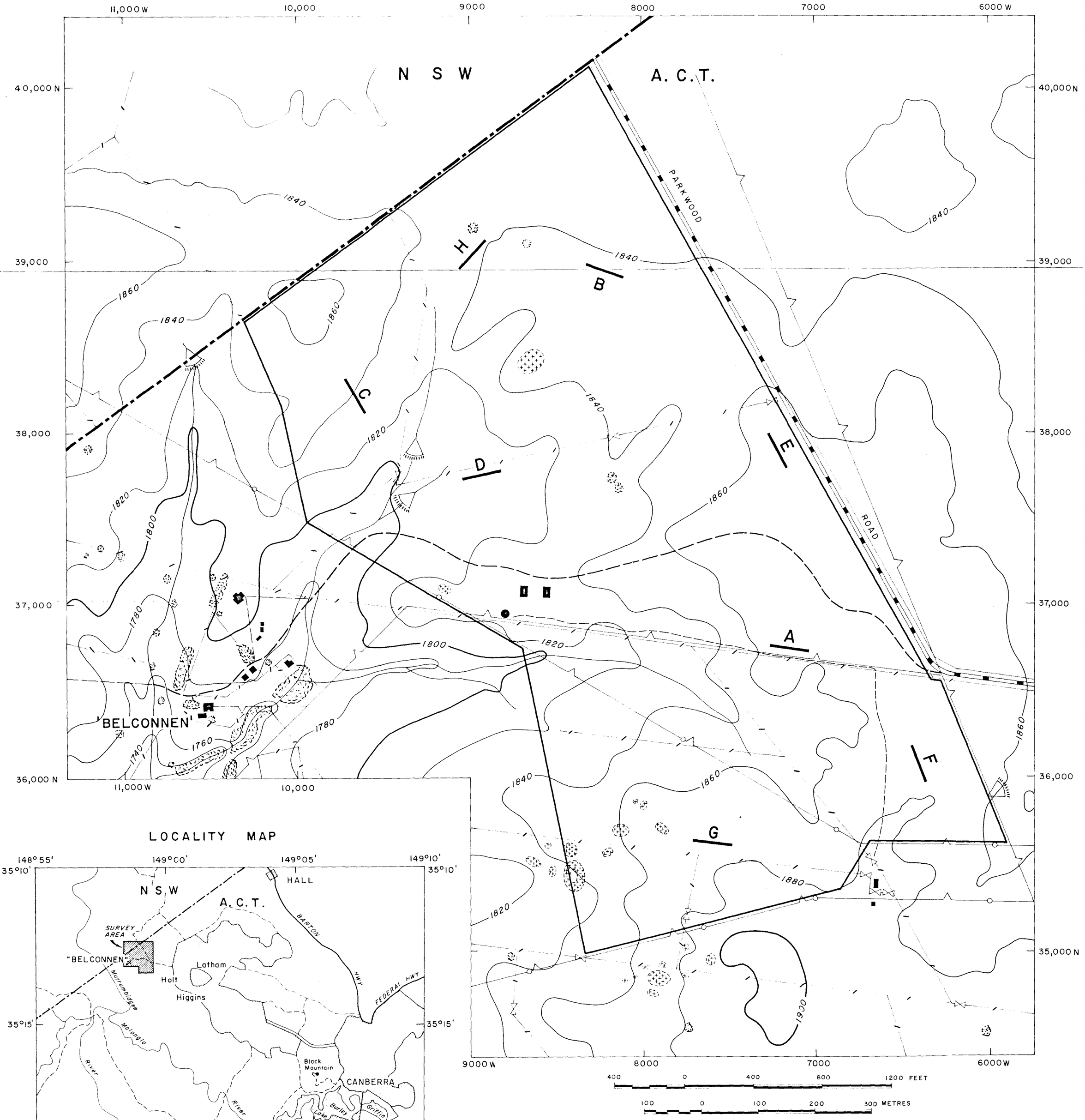
HAWKINS, L.V., 1961 - The reciprocal method of routine shallow seismic refraction investigations. Geophysics, 26(6), 806-19.

HILL, P J., 1971 - Hall Gravel quarry seismic refraction investigation, A.C.T. 1971. Bur. Miner. Resour. Aust. Rec. 1971/102.

VAN DEN BROEK, P.H., 1971 - Geological evaluation of the proposed Belconnen refuse disposal area, Canberra City District, A.C.T. Bur. Miner. Resour. Aust. Rec. 1971/132.

WYLIE, K.M., 1968 - Finding the best place to bury our past. The Testing World No. 21 (Winter, 1967/68).

PLATE I



LOCALITY MAP

PROPOSED REFUSE DISPOSAL AREA, BELCONNEN A.C.T. 1971

TRAVERSES LOCATION, AND LOCALITY MAP

LEGEND

- FENCE
- GATE
- POWER LINE
- TRANSMISSION TOWER
- FARM DAM
- BUILDING
- TREES
- LOOSE SURFACE, ALL WEATHER SECOND CLASS ROAD
- LOOSE SURFACE, DRY WEATHER ROAD
- UNIMPROVED EARTH ROAD
- ROCK OUTCROP
- ELEVATION CONTOUR
- PROPOSED BOUNDARY
- TRAVERSE
- CONTOUR INTERVAL 20 FEET

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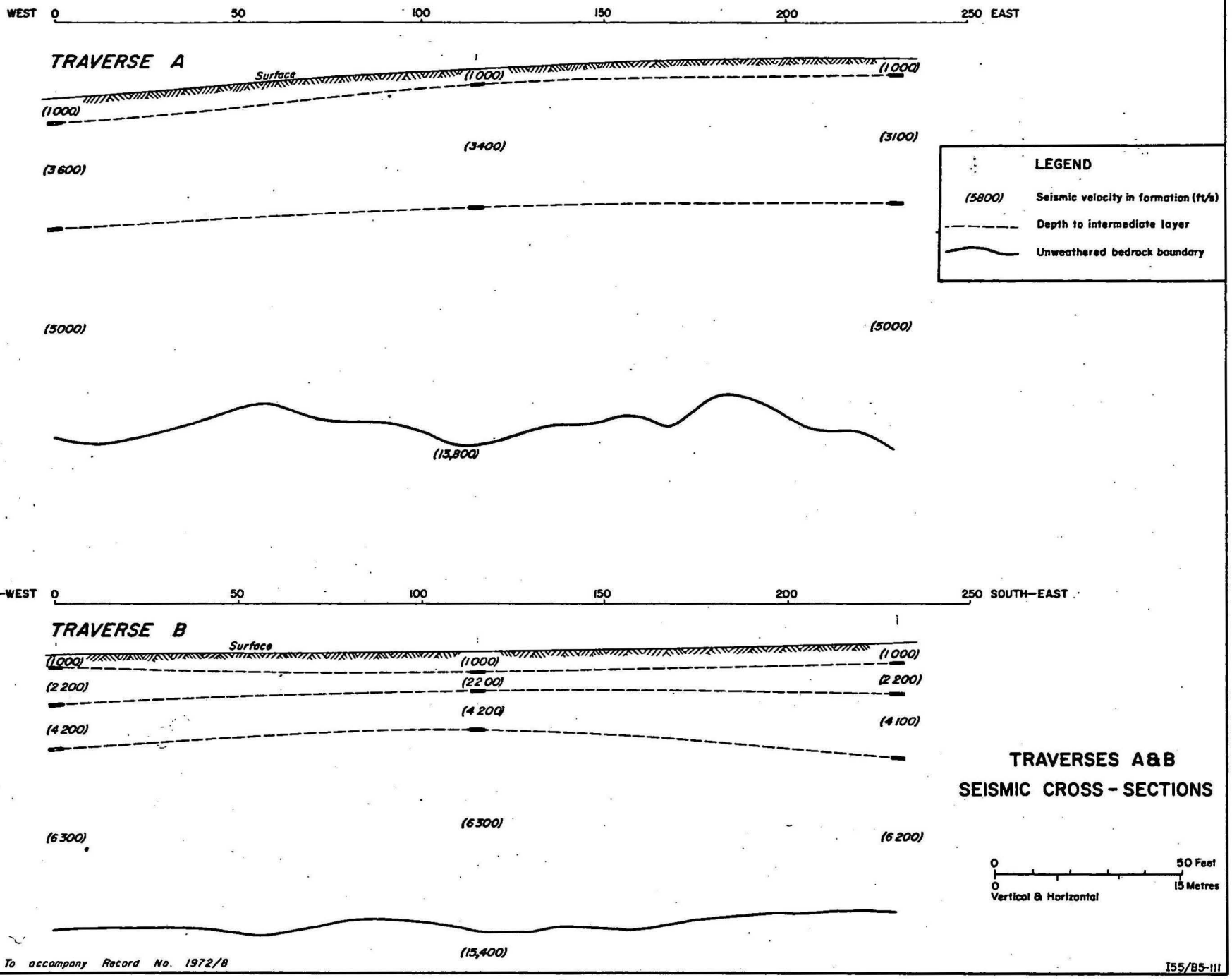

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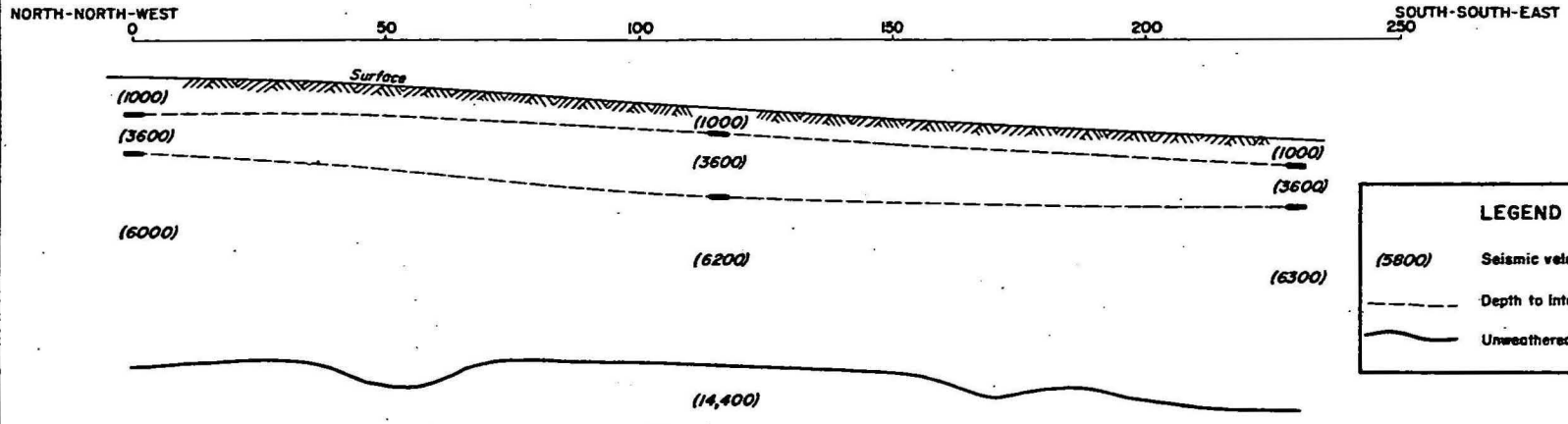
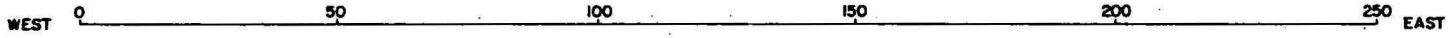
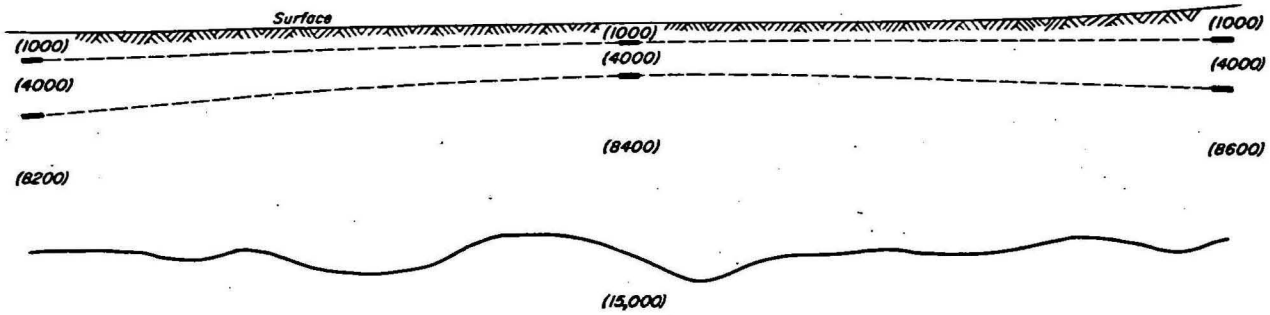
PLATE 3

TRAVERSE C





TRAVERSE D



TRAVERSES C&D
SEISMIC CROSS - SECTIONS

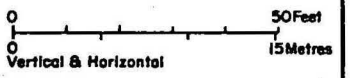


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PLATE 4

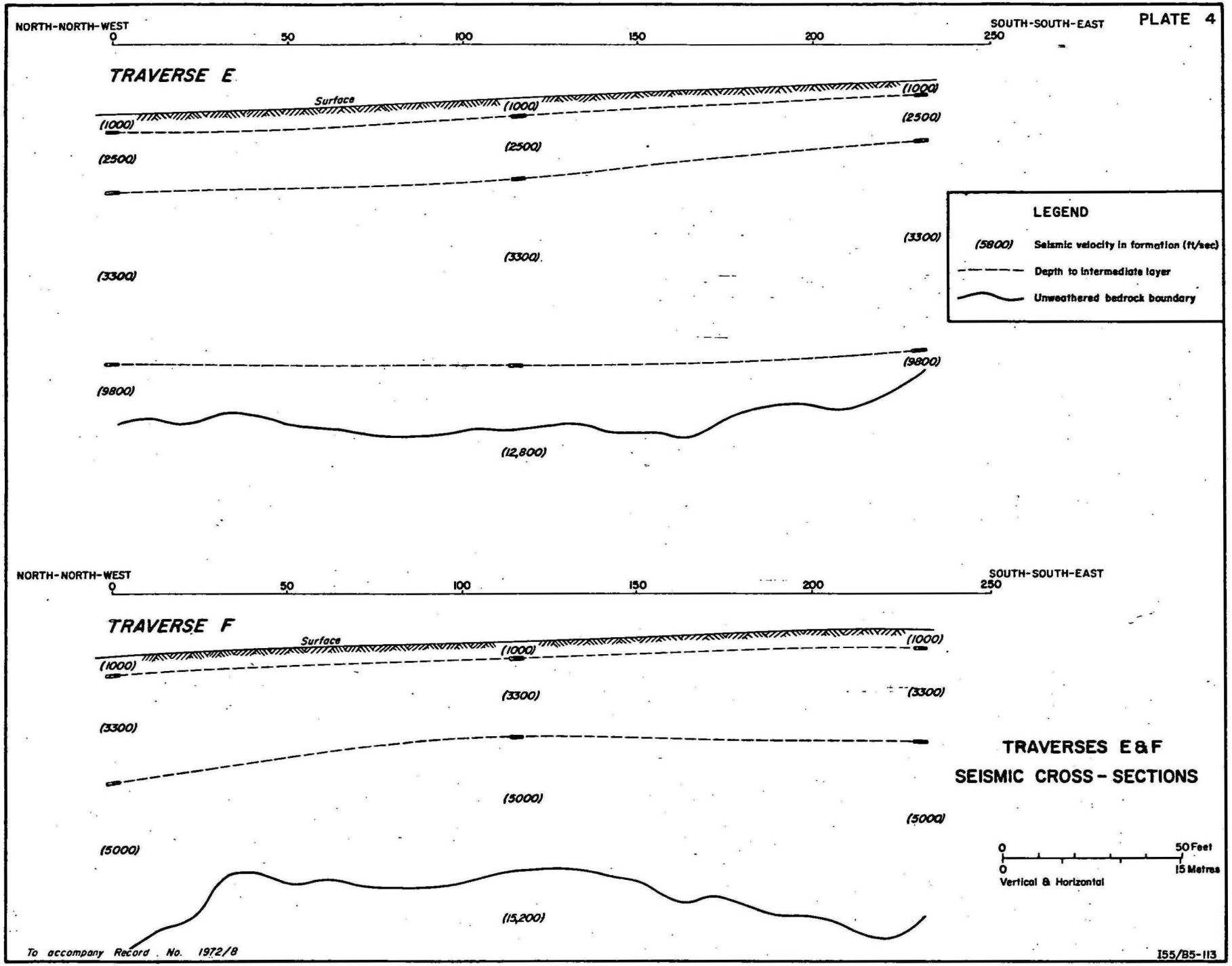

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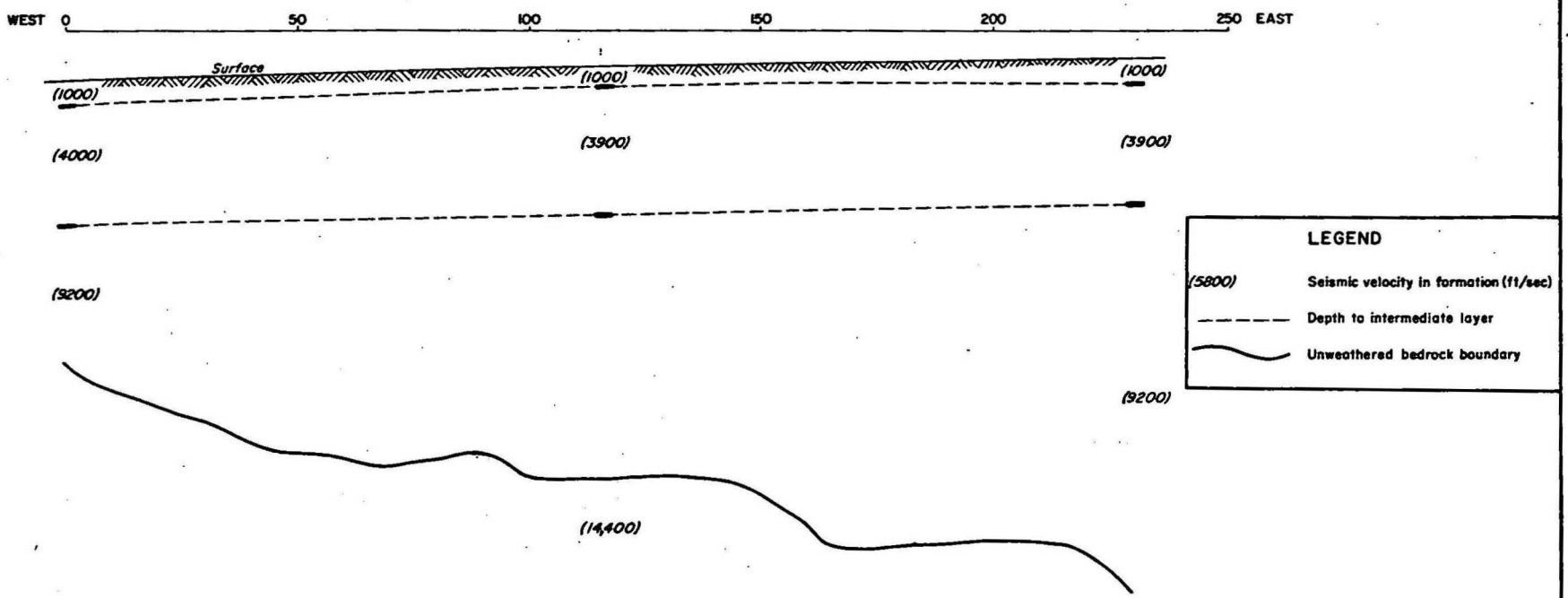
PLATE 5

TRAVERSE G



LEGEND

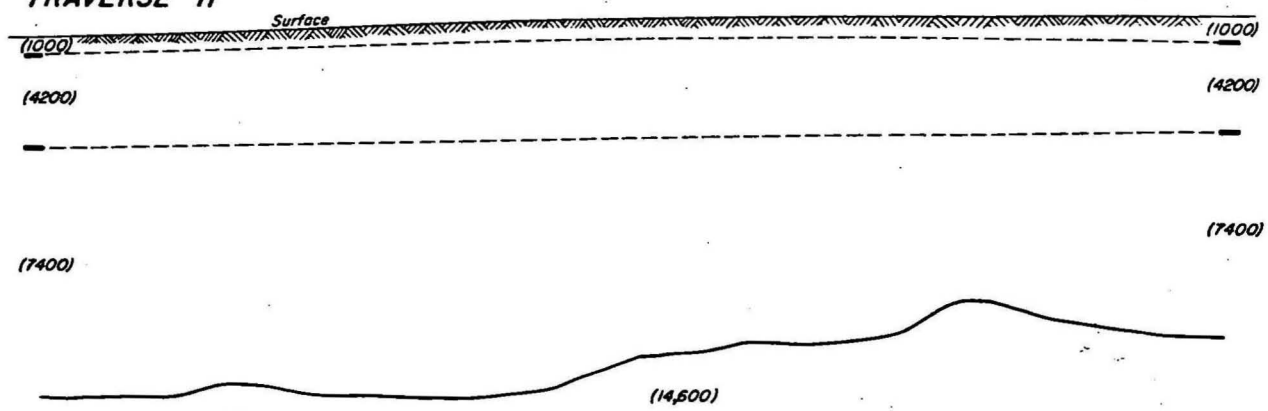
(5800) Seismic velocity in formation (ft/sec)

Depth to intermediate layer

Unweathered bedrock boundary

SOUTH-WEST 0 50 100 150 200 250 NORTH-EAST

TRAVERSE H



TRAVERSES G & H
SEISMIC CROSS-SECTIONS

0 50 Feet
0 15 Metres
Vertical & Horizontal

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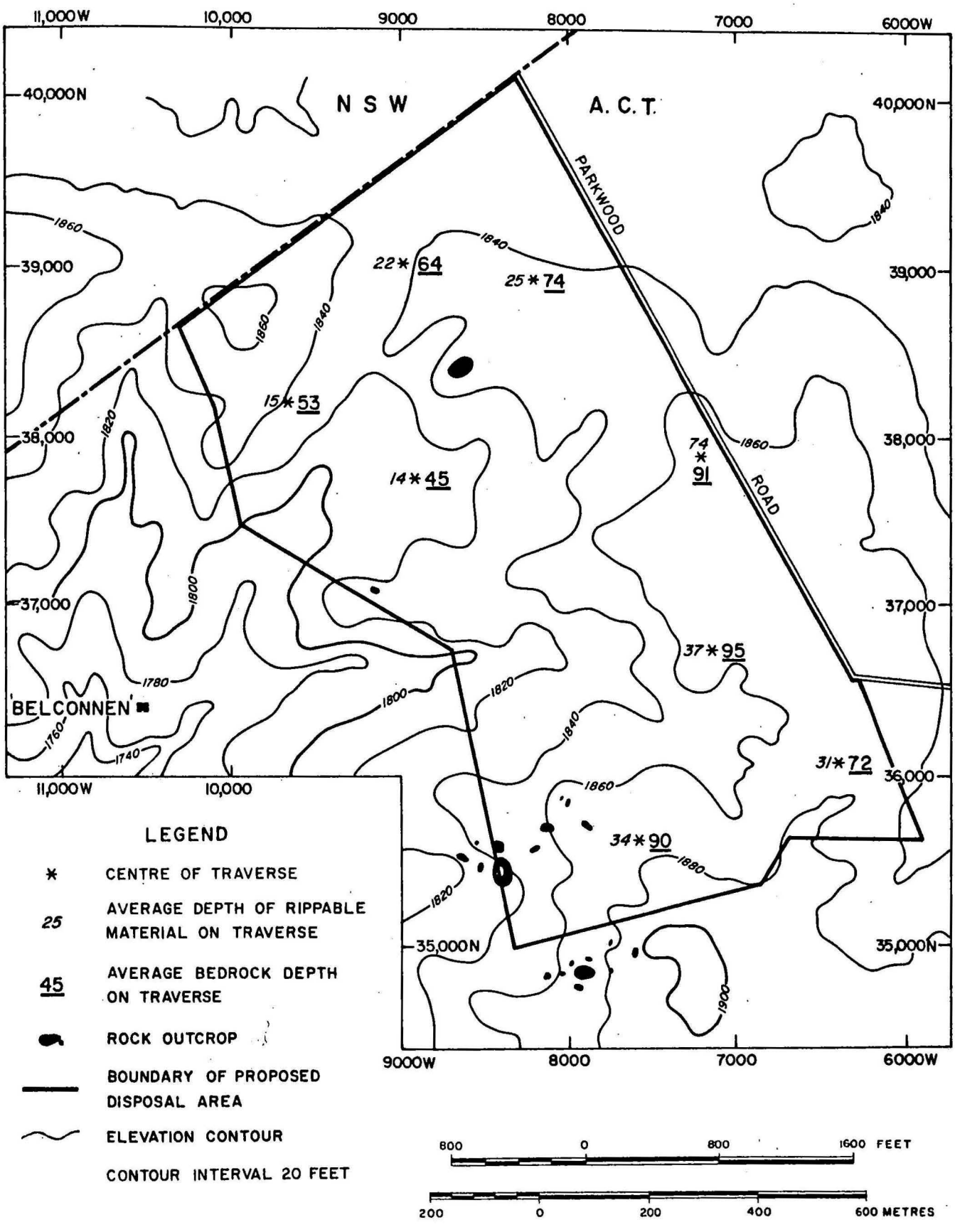

AVERAGE DEPTHS OF RIPPABLE MATERIAL AND BEDROCK ON TRAVERSES

To accompany Record No. 1972/8

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