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COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record 1972/121

MOUNT STROMLO WATER TREATMENT PLANT STORAGE RESERVOIR SITE - SEISMIC REFRACTION SURVEY

by

I.D. Bishop and F.J. Taylor

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ILLUSTRATIONS

SUMMARY

A seismic refraction survey was conducted by the Bureau of Mineral Resources, Geology & Geophysics to determine the subsurface geology and excavation conditions for a proposed storage reservoir at the Mount Stromlo water treatment plant.

Bedrock, with seismic velocity ranging from 2600 to 3800 metres per second, was found to occur generally at a depth of about 7 m but was not readily mappable because of some subsurface condition which induced depth inconsistencies in intersecting traverses. However, it appeared that, to the required depth of excavation, the rock would be rippable except at the extreme northern edge of the site.

1. INTRODUCTION

The construction of a storage reservoir and associated pipelines is being planned by the Commonwealth Department of Works for the National Capital Development Commission (Plate 1). The reservoir will be 76.2 m in diameter and have a floor level of 711 m above S.L. Excavations of up to 10 m will be required. The major outlet will be a 1.58 m diameter mild steel, concrete-lined pipe.

The Bureau of Mineral Resources, Geology & Geophysics (BMR), following a request by the Department of Works, agreed to carry out a seismic refraction survey at the site to investigate subsurface geological conditions and thus predict excavation requirements. The field work was completed in March 1972 by a geophysical party from BMR's Engineering Geophysics group. The party consisted of F.J. Taylor (Geophysicist and Party Leader), I.D. Bishop (Geophysicist) and one draftsman. The locations of the seismic traverses are shown in Plate 2.

Movement of water to Canberra through a nearby valve caused vibrations which made seismic work impossible. In order to obtain satisfactory results it was necessary to turn off this water for five hours.

2. GEOLOGY

The region was mapped by Henderson & Strusz (1970), and the 1:50 000 map of Canberra gives the area under investigation as being part of a wide expanse covered by coarse-grained, thickly bedded dacite and rhyodacite of the Deakin Volcanics formation. These rocks are of Upper Silurian age.

3. METHOD AND EQUIPMENT

BMR's standard engineering refraction equipment consisting of a 24-channel SIE seismograph and 20-Hz TIC geophones was used for the survey. Geophone spacing was 4 m on traverses A, B, C, D, and E, and 2 m on the shorter traverse F. Reciprocal geophones were placed about 30 m beyond the end of each spread except where existing structures (buildings, pipelines) prevented firing from these points. Apart from the reciprocal firings, other shot-points on each spread were 1-2 m from each end and in the centre of the spread. Interpretation was based on the time-intercept method (Dobrin, 1952).

4. SEISMIC DETERMINATION OF RIPPABILITY

Since the seismic velocity of a rock layer increases as its hardness and degree of consolidation increase, an assessment of the rippability of a particular rock unit can be obtained from the seismic velocity. This correlation can serve as no more than an indication, however, because many factors remain undetermined. The actual type of rock and its history (conditions of deposition, weathering, jointing, etc) will influence the rippability of the rock as defined for a particular piece of excavating equipment.

The Caterpillar Tractor Company has published (1966) a complete set of seismic rippability charts for Caterpillar equipment. From these charts and local observations (Hill, 1971) it seems that rock with seismic velocity below 1400 m/s will be rippable using medium-sized equipment, and this limit may extend up to 1800 m/s. Heavy equipment with mounted hydraulic rippers may be effective in a weathered igneous rock with velocity up to 2200 m/s.

5. RESULTS

A number of difficulties were encountered in the interpretation of the seismic records. At traverse intersection points, large differences (up to 100%) were found between delay-time values (i.e. apparent depth to bedrock) at the same point, while the basement velocity showed apparent variation from 2600 to 3800 m/s. These difficulties make detailed mapping of bedrock rather meaningless, although calculation of delay-times using reciprocal shots on any one traverse gave consistent results.

The results suggest that the weathering pattern is seismically complex, as would be the case if tors have been formed, as is possible here. Drilling results (Table 1) show a similar irregularity: fresh rock appears at shallow depth in hole 3 but not elsewhere.

The wide range of velocities between surface and basement also indicates a complex weathering pattern. The seismic velocities observed can however, be grouped into four general classifications:

300 - 400 m/s	-	soil
600 - 800 m/s	-	clay or completely weathered rock
1100 - 2000 m/s	-	moderately to highly weathered rock
2600 - 4000 m/s	-	slightly weathered rock

The second of these was observed only west of the roadway on traverses D and E, and could correspond to road material deposited on the slope.

As far as it was possible to define bedrock position (Plates 3 and 4) its depth was about 7m, and thus only at the northern edge of the site does bedrock occur within the material to be excavated.

Along the line of the outlet pipe (traverse F) the bedrock (2800 m/s) was found to be deeper, ranging from about 10 m to 15 m.

6. CONCLUSIONS

No unweathered rock seems to have been observed, but slightly weathered rock of uneven velocity is generally about 7 m below the surface, and should therefore be encountered during excavation at the northern edge of the site. In this area it seems that blasting will be required for excavation.

Table 1. Simplified Results of Test Drilling

Hole No.	Position and Orientation	Result	
1.	Intersection of traverses C & D; drilled vertically	0-6 m	completely weathered
		6-12+ m	highly weathered
2.	2.7 m west of point A40; drilled at -70° due north	0-6 m	completely weathered
		6-13+ m	highly to moderately weathered
3.	Intersection of traverses B & D; drilled vertically	0-6 m	completely to highly weathered
		6-7.5 m	highly to moderately weathered
		7.5-8.5+m	fresh stained
4.	7.6 m bearing 050° from A40; drilled at -70° bearing 330°	0-9 m	completely to highly weathered
		9-11 m	moderately weathered
		11-14+m	moderately to slightly weathered

7. ACKNOWLEDGEMENT

The authors wish to thank the officers of the treatment plant for their co-operation in controlling the water supply to allow the survey to proceed.

8. REFERENCES

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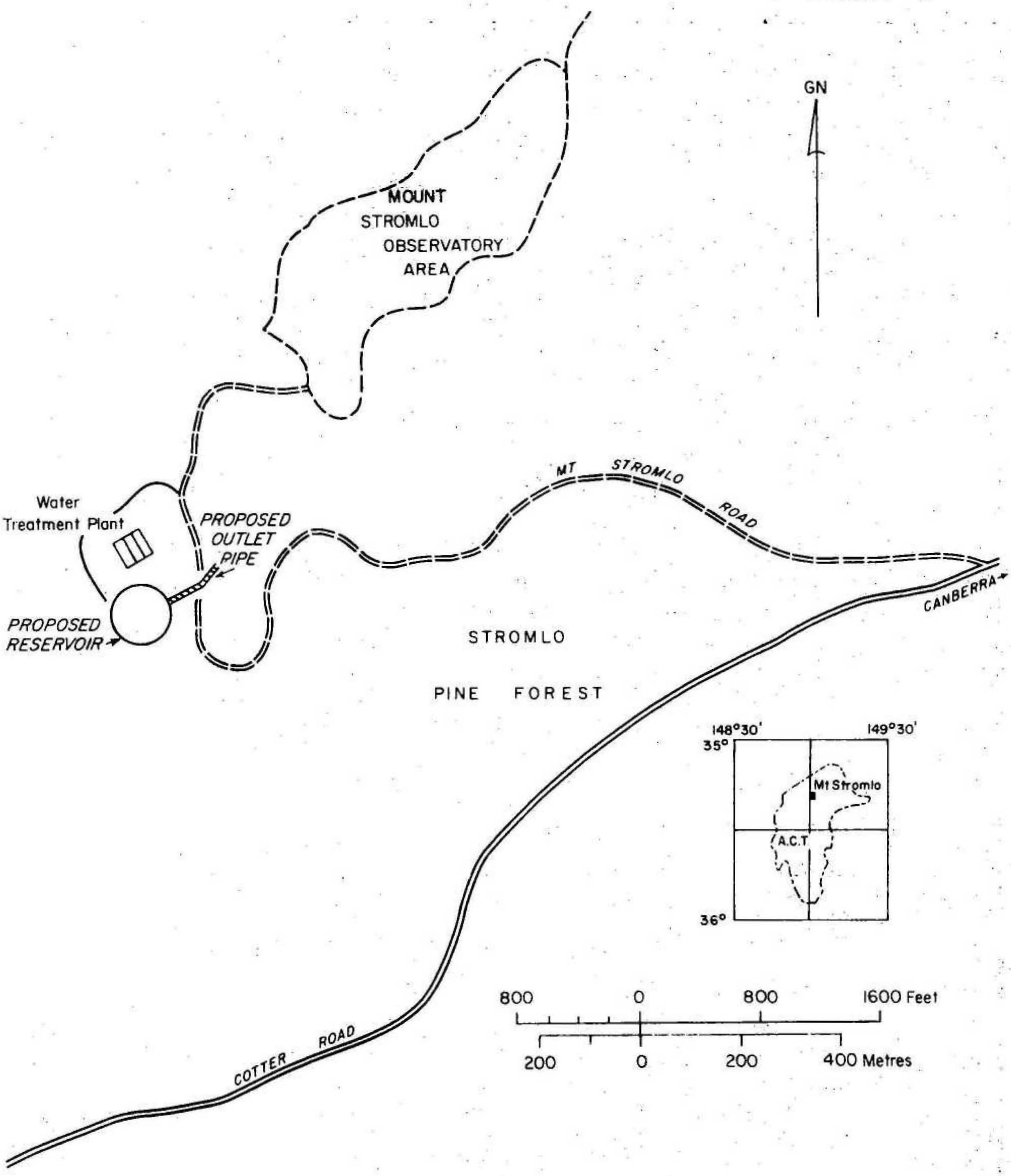
HILL, P.J., 1971 - Hall gravel quarry seismic refraction investigation, A.C.T. 1971. Bur. Miner. Resour. Aust. Rec. 1971/102 (unpubl.).



LOCALITY MAP

MOUNT STROMLO WATER TREATMENT PLANT BALANCING STORAGE

To accompany Record No 1972/121

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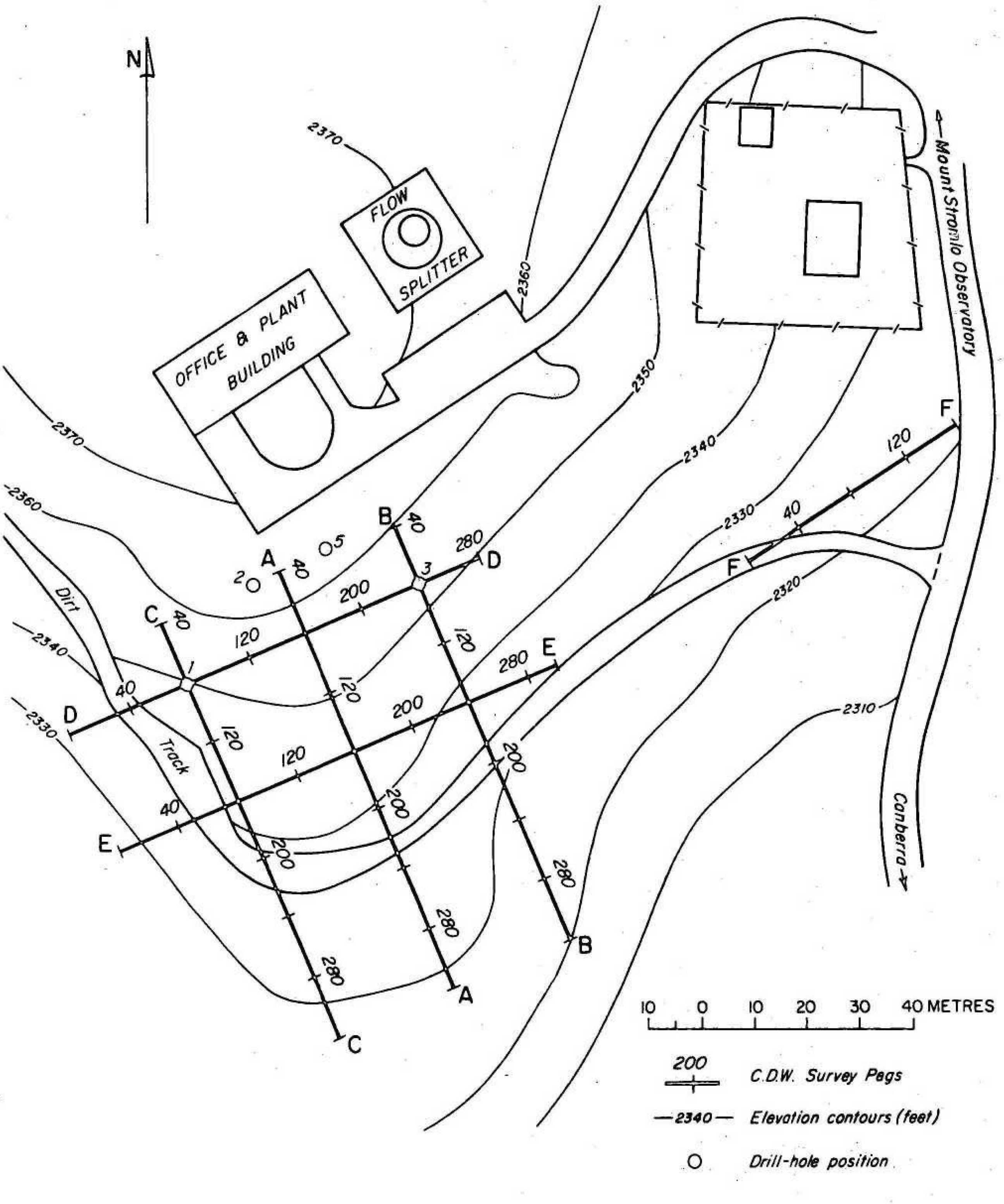
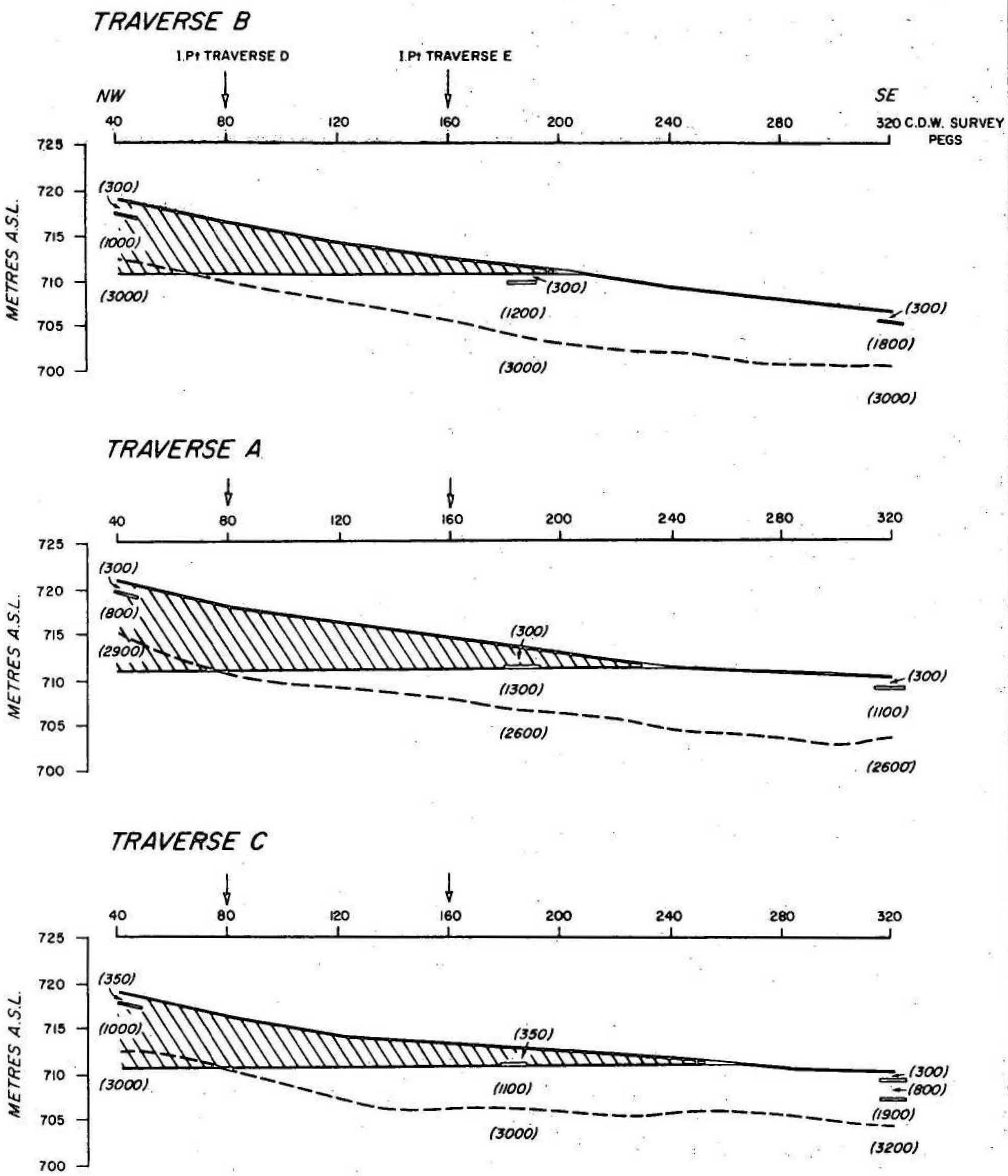


SITE PLAN SHOWING POSITION OF TRAVERSES

PLATE 3



LEGEND

Section to be excavated

Interpolated boundary

Proposed base of water tank 711metres A.S.L.

(3000) Seismic velocity in formation (m/sec)

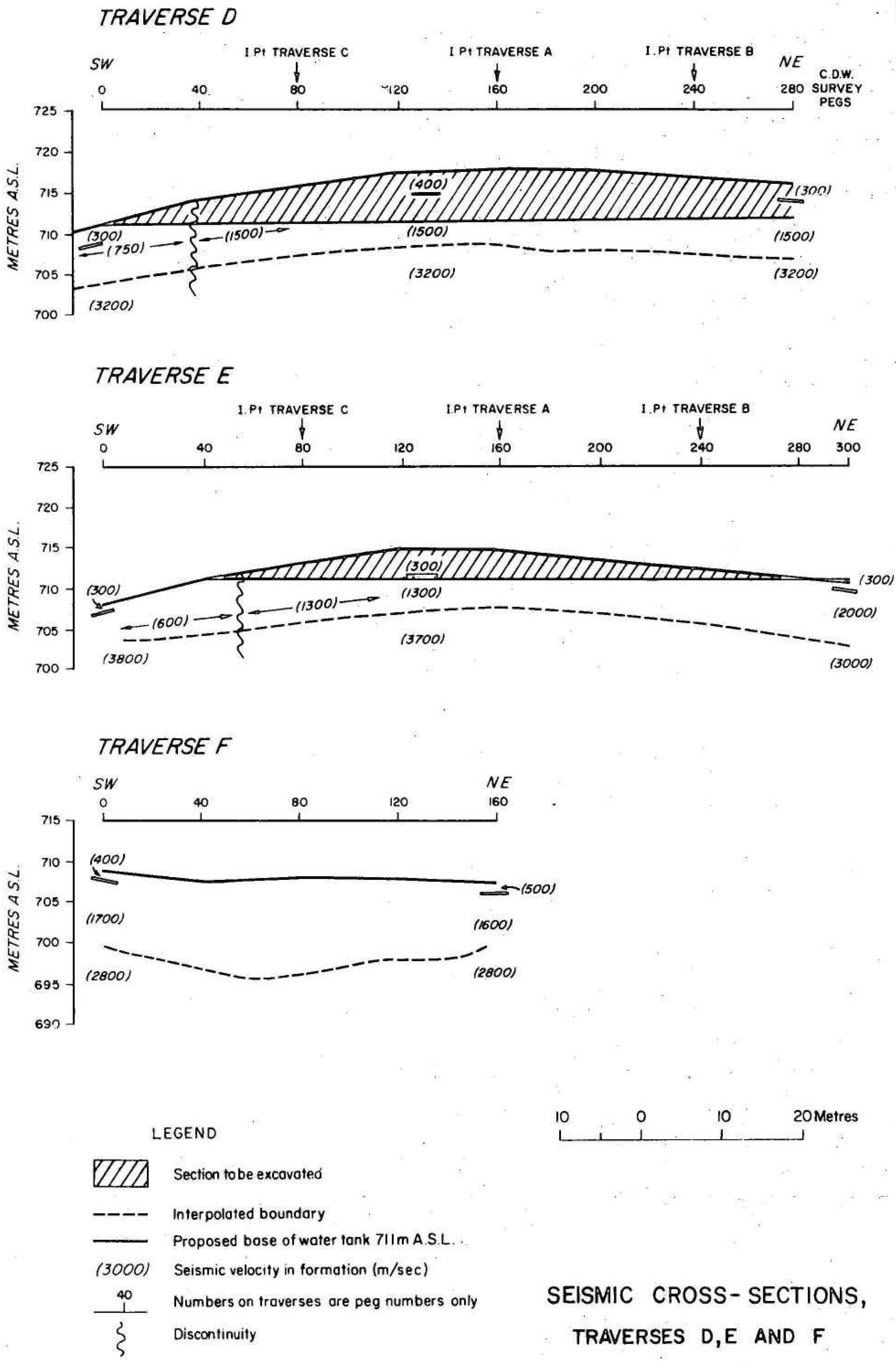
40 Numbers on traverses are peg numbers only

10 0 10 20 Metres

SEISMIC CROSS-SECTIONS

TRAVERSES A, B AND C

PLATE 4



SEISMIC CROSS-SECTIONS,

TRAVERSES D, E AND F

To accompany Record No 1972/121

I55/B5-I59A