DEPARTMENT OF
MINERALS AND ENERGY

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record 1975/5

TUGGERANONG TOWN CENTRE WATER FEATURE, SEISMIC REFRACTION SURVEY, A.C.T., 1974

by

F. N. Michail

Record 1975/5

TUGGERANONG TOWN CENTRE WATER FEATURE, SEISMIC REFRACTION SURVEY, A.C.T., 1974

by

F. N. Michail

CONTENTS

ILLUSTRATIONS

SUMMARY

The Bureau of Mineral Resources, Geology and Geophysics (BMR) carried out a seismic refraction survey, at the request of the National Capital Development Commission (NCDC), to investigate the proposed Tuggeranong water feature. The aim of the survey was to determine subsurface conditions, depth to bedrock, rippability within the proposed site, and to provide information on the geological conditions.

Depth to bedrock varies over the damsite from 2 to 22m. Bedrock velocity ranges from 3200 to 5300 m/s. Two low-velocity zones were indicated, which agree with the geological map of the area and the aerial photo lineation.

1. INTRODUCTION

As part of the development of the Tuggeranong town centre, a water feature is planned. It is proposed to form a dam and an artificial lake on Village Creek by use of the road embankment of the proposed South Woden arterial. The area is about 18 km southwest of Canberra (Plate 1). BMR was asked by NCDC to investigate the geological conditions along the proposed embankment axis and in the area of the stilling basin. The aim of the seismic investigations was to assist with the planning and construction of the dam along the centreline of the freeway, to determine excavation conditions and to define the rock quality under the site.

The seismic refraction survey was carried out by the Engineering Geophysics Group of BMR. Four seismic traverses totalling 828 m were surveyed. The location of traverses is shown in Plate 1. A geophysical party consisting of F.J. Taylor (Geophysicist and Party Leader), G. Jennings (Technical Officer), M. Dickson (Technical Assistant), and L. Rickardsson (Field Hand) conducted part of the survey during November 1973 and another party consisting of F.N. Michail (Geophysicist and Party Leader), and A. Gleeson and G. Baker (Field Hands) completed the survey during March 1974. The interpretation of the seismic results was carried out by F.J. Taylor (traverses A and B), and by F.N. Michail (traverses C and D).

2. GEOLOGY

The geology of the area is described by Gardner (1968), Rossiter (1971), and Purcell (in prep.). Bedrock at the site consists of welded dacite tuff of Upper Silurian age. Thick soil covers much of the area. Some closely jointed, fractured, and sheared zones exist in rock exposures in Tuggeranong Creek.

3. EQUIPMENT AND METHOD

The equipment used consisted of a standard BMR 24-channel SIE-refraction seismograph with HSJ 14 Hz geophones. Each seismic spread consisted of 23 geophones with a 24th geophone as the reciprocal. The geophone spacing used on all spreads was 4 m. Seismic recordings were made for shots fired at the centre of the spread and 1 m off each end. Long shots were also fired at some offset distance (20-50 m) beyond each end, and in line with the spread. Traverses A, B, C, and D were made; traverse A was laid along the embankment axis of the proposed dam on the proposed South Woden arterial centreline, traverse B across the spillway, and traverses C and D parallel to the costean (Plate 1). Traverses C and D were to define the limits of any major defect zone within the bed of Tuggeranong Creek.

The seismic refraction method (Heiland, 1946) was used in this survey. Depths to different velocity layers of traverses A and B were calculated at the shot-points using intercept-times. The reciprocal-time method (Hawkins, 1961) was used on traverses C and D to determine the depth to bedrock under each geophone.

4. RESULTS

The seismic velocity cross-sections of all traverses are shown in Plates 2-4.

Correlation of seismic velocity layers with rock type is interpreted in three broad groups as follows:

1)	400 - 800 m/s	soil and completely weathered rock.
2)	900 - 1600 m/s	completely to moderately weathered dacite.
3)	2200 - 5300 m/s	slightly weathered to fresh dacite, depending on shear zones and joints.

For excavation purposes, it can be considered that completely to moderately weathered dacite with velocity less than 1500 m/s is rippable by bulldozers similar to D-8 and fitted with hydraulic rippers; blasting will be required to remove material with higher velocity.

The thickness of soil cover ranges from zero to 5 m, and the depth to fresh dacite varies from about 2 m below Tuggeranong Creek to 22 m on the northern slopes.

Bedrock velocity recorded ranges from 2200 to 5200 m/s, depending on its degree of weathering and the presence of jointing or shear zones. Two low-velocity zones are indicated along traverse A:

(1) The first zone occurs at the intersection of traverses A and B, which is interpreted as representing a possible shear zone or fault zone. This is indicated in the higher seismic velocity recorded on both sides of the lower-velocity zone, and in the time-distance curve as significant change in the first-arrival times.

(2) The second zone occurs between chainages 18840 m and 18880 m and is explained as a possible fault zone or shear zone in the direction of the air-photo lineation as indicated by the geological map of the area (Pl. 2).

On traverses C and D, depth to bedrock (2200 - 4800 m/s) varies from about 3 to 10 m. A slightly weathered dacite (3200 m/s) is indicated on traverse D at a depth 1.5 to 4 m. This layer is not indicated on traverse C, which could be due to its small thickness. This has caused the refracted rays not to be revealed on the seismic time-distance curve and therefore is missed in computation. The eastern parts of traverses C and D showed the occurrence of the low-velocity zone indicated on the south part of traverse A.

On traverse B, a diamond-drill hole (WF2) was drilled at chainage 120 m to a total depth of 24 m. The drilling results agreed very well with the seismic interpretations (Pl. 3).

5. CONCLUSIONS AND RECOMMENDATIONS

The thickness of weathering is greater on the north side of the site where depth to bedrock is about 22 m. Depth to bedrock under Tuggeranong Creek is only about 2 m. Weathered rock with velocity up to 1500 m/s will be rippable, but blasting will be required for higher-velocity rock. Two low-velocity zones were indicated on traverses A, which are part of the major geological feature shown by the aerial photo lineation. The diamond-drill hole (WF2) confirmed the seismic interpretations. Further investigation by diamond-drill holes is recommended.

6. REFERENCES

GARDNER, D.E., 1968 - Preliminary notes on the geology of the Tuggeranong urban development area, A.C.T. Bur. Miner. Resour. Aust. Rec. 1968/75 (unpubl.).

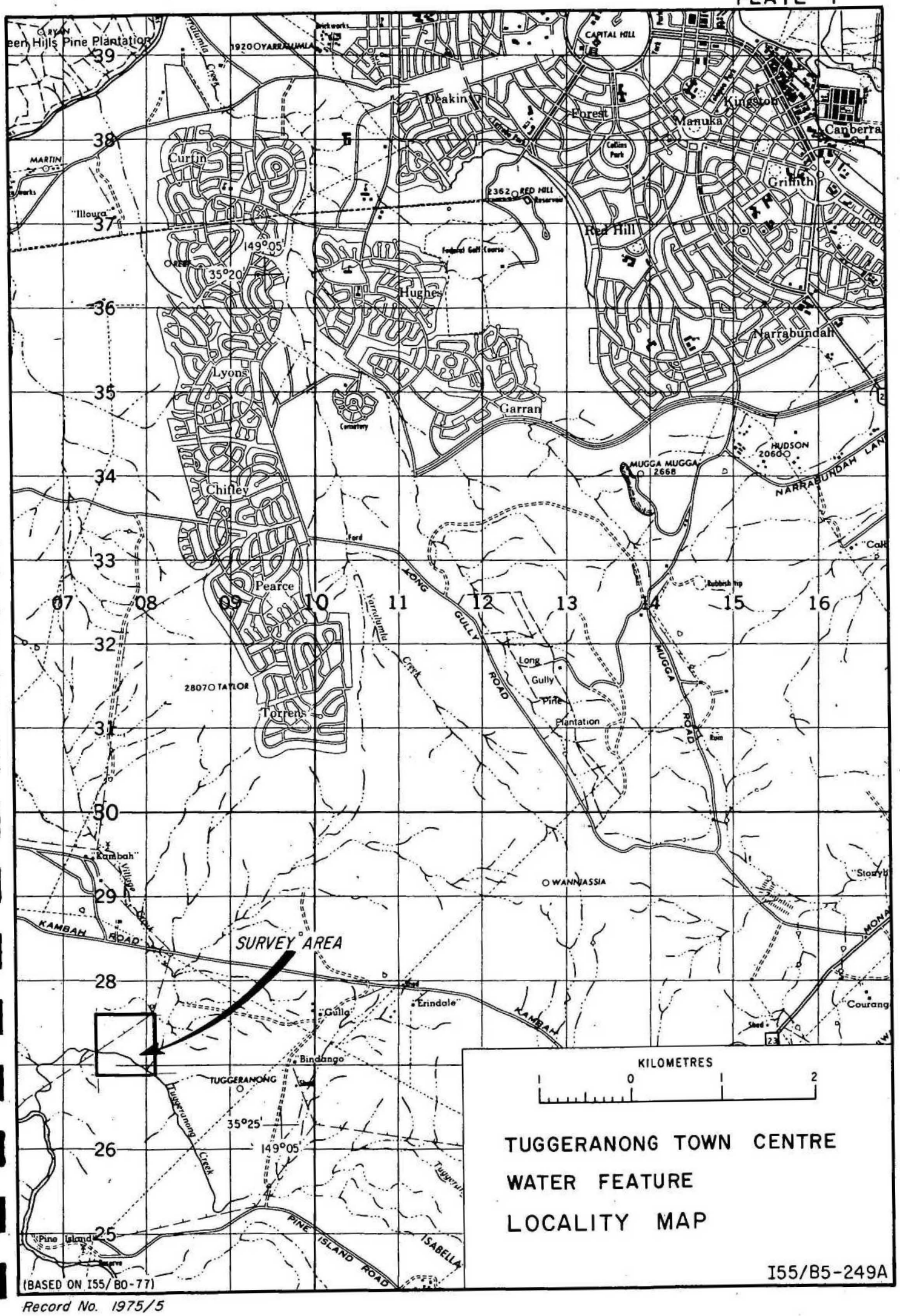
HAWKINS, L.V., 1961 - The reciprocal method if routine shallow seismic refraction investigations. Geophysics, 26(6), 806-19.

HEILAND, C.A., 1946 - GEOPHYSICAL EXPLORATION. N.Y. Prentice Hall

PURCELL, D.C., in prep. - Geological investigations, proposed Tuggeranong dam site, A.C.T. Bur. Miner. Resour. Aust. Rec. (unpubl.) .

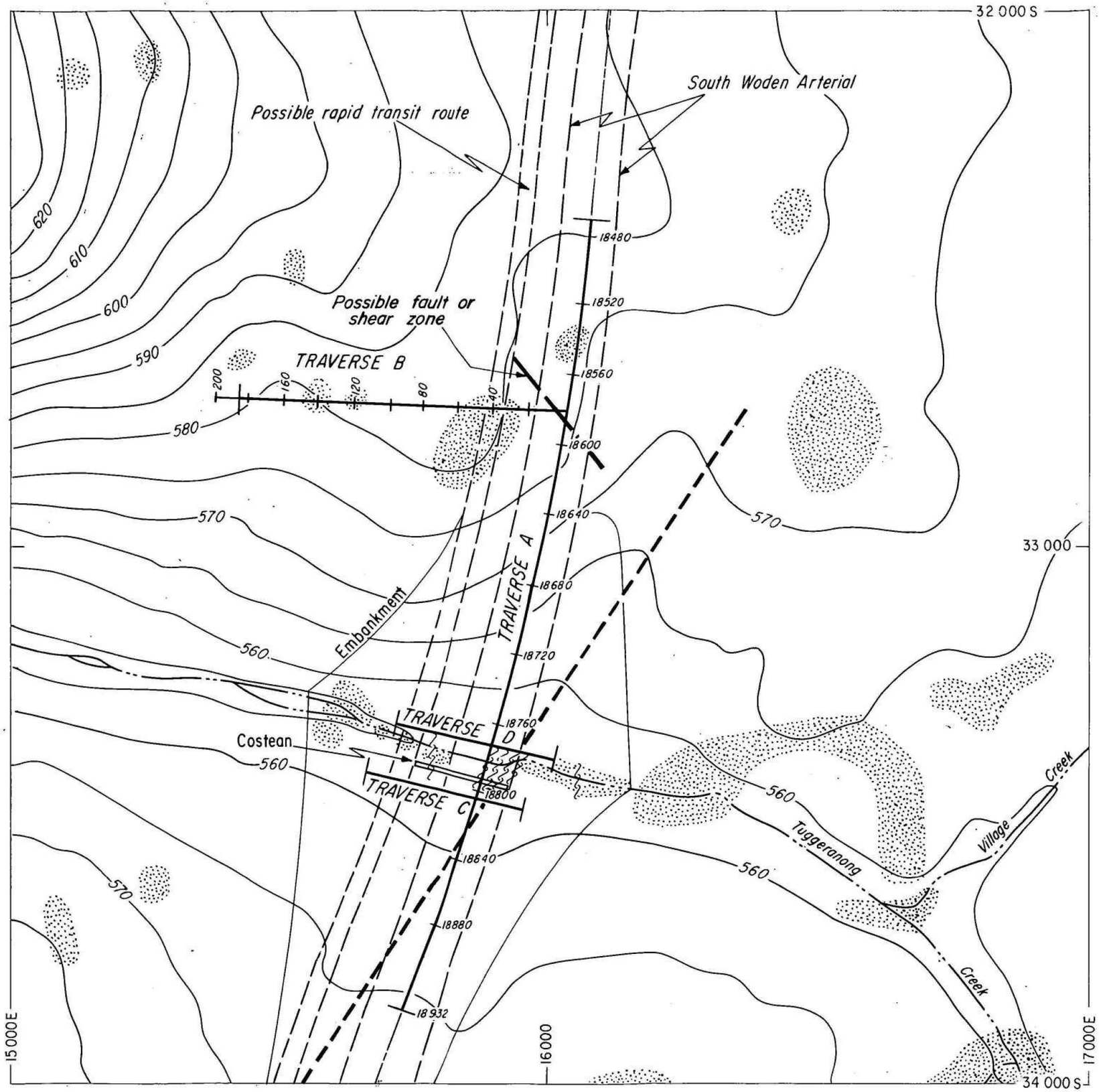
ROSSITER, A.G., 1971 - Preliminary notes on the geology of the Village Creek area, A.C.T. Bur. Miner. Resour. Aust. Rec. 1971/11 (unpubl.).

PLATE 1



Record No. 1975/5

PLATE 2



LEGEND

160 120 — Traverse showing chainage in metres

570 — Elevation contours (5 metre interval)

Stream

Rock outcrop

Shear zone

Lineation shown on air photographs

Co-ordinates refer to Mt Stromlo Grid and are in feet

METRES

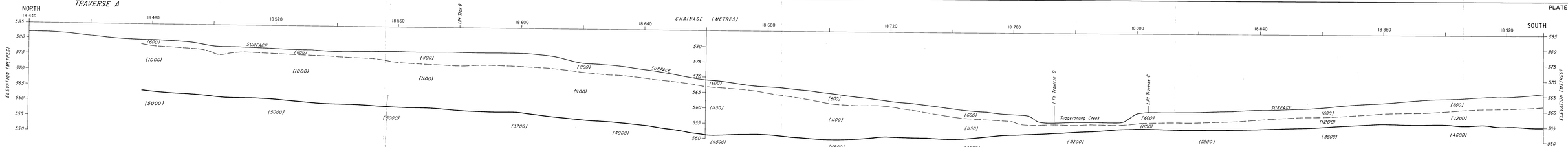
0 100 200

TRAVERSE PLAN AND GEOLOGY

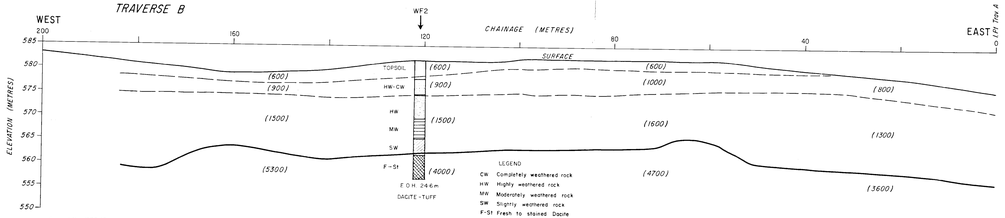
Record No. 1975/5

I55/B5-250

TRAVERSE A

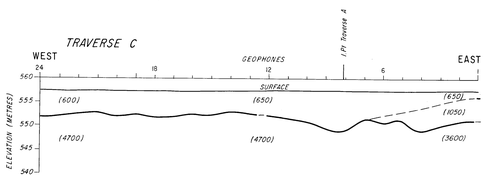


TRAVERSE B

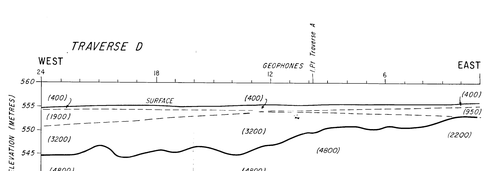


Record No. 1975/5

TRAVERSE C



TRAVERSE D



(4700) = Seismic velocity in formation (metres/second)

SEISMIC CROSS-SECTIONS