

DEPARTMENT OF MINES
SOUTH AUSTRALIA

GEOLOGICAL SURVEY
EXPLORATION SERVICES DIVISION

LAND SLIP ON GORGE ROAD NEAR THE KANGAROO CREEK DAM
SEISMIC SURVEY

by

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22nd November, 1973

Rept.Bk.No. 73/280
G.S. No. 5284
D.M. No. 1227/68

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PLANS

<u>Plan No.</u>	<u>Title</u>	<u>Scale</u>
73-786	Land slip on Gorge Road Chainage 8100' Seismic Survey Locations of traverses.	1" = 20 ft.
73-787	Land slip on Gorge Road Chainage 8100' Seismic traverses 1-4 and sections A-A' to C-C'	1" = 20 ft.

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ABSTRACT

The seismic refraction technique was used over a land slip occurring on the Gorge Road near Kangaroo Creek Dam in an attempt to outline zones of weakness and to determine depth to bedrock. No serious zones of weakness were detected within the bedrock refractor and it seems likely that the slip has been caused by the slipping when wet of well-fissured clays which form part of the natural overburden.

Unweathered bedrock seems to lie at a depth of about *30 feet (9 metres) below the level of the main road.

INTRODUCTION

The land slip occurs near chainage 8 100 feet on the main Gorge Road. Near this point an access road constructed by the Engineering & Water Supply Department leads from the level of the main road down to water level, a drop of about 100 feet. The slip has been continuing for a period of several months and at the time of this survey had reached a stage where several feet of this access road had been lost.

A preliminary seismic and resistivity survey was made on 26th October, 1973, followed by a more extensive survey on

* The foot-pound-second system of units has been adopted for this report to conform with Highways Department work.

31st October, 1973. Officers of the Geological Survey present were the author, R.S. Turner (Senior Technical Officer) and B.A.C. Brice (staff field assistant).

GEOLOGY

The location is shown in Plan No. 73-786. The Gorge Road skirts along the sides of the narrow steep-sided gorge which contains Kangaroo Creek Dam. Rocks in the area consist of the Pre-Cambrian rocks of the Barossa Complex forming the Houghton Inlier and sediments of the Adelaide System forming a series of broad folds. The general trend is in a north-easterly direction.

Where the land slip occurs the bedrock is a schistose metamorphic rock forming part of the Houghton Inlier. Overlying this are illite clays which are well-fissured and form the naturally occurring land surface. The fill used to construct the access road lies on top of these and appears to have been laid down in places to a thickness of possibly 30 feet or more. It appears to consist of boulders and cobbles of schistose material in a matrix of sands and clays.

PREVIOUS GEOPHYSICAL WORK

J.J. Hussin carried out seismic and resistivity traverses in 1965 during preliminary work on the dam site. This work was reported on in South Australian Department of Mines docket No. DM.596/64. He found that a very complex weathering profile existed and that rock velocities ranged from 4 000 to 7 500 feet per second.

METHODS AND EQUIPMENT USED

A Texas Instrument Company P19 recording seismograph was used to obtain a record of geophone response to shots fired at depths of up to 6 feet below ground surface. Twelve geophones were arranged in in-line spreads as shown in plan No. 73-786. After timing the records for first arrivals and then correcting for the depths at which the shots were fired the results were plotted as time-distance curves which were then analysed for velocities and depths of the various layers. Two bracketing shots fired out from the end of each spread were used to give more detailed information, by means of reciprocal times, on the true velocity and depths of the bedrock refractor.

A resistivity depth probe, employing the Schlumberger array, was made along the same line as seismic traverse No. 1 in an attempt to delineate the boundary between the fill and the naturally occurring surface, since it was felt that the fill should have a higher resistivity than the underlying clay.

RESULTS AND INTERPRETATION

The cross-sections shown in Plan No. 73-787 are compiled from the interpretations of the geophysical survey.

Two layers with distinct seismic velocities appear in both traverse 1 and traverse 2. The uppermost layer has a velocity of about 2 000 feet/sec. and probably corresponds to compacted clay and/or fill. The velocity of the lower layer is 10 200 feet/sec. under traverse 2 and 6 100 feet/sec. under traverse 1. Moreover the lower layer on traverse 2 appears to lie at a lower elevation than that on traverse 1.

This apparent dilemma may be resolved if we postulate that a 6 100 ft./sec. "blind zone" (see Hawkins and Maggs, 1961) overlies the 10 200 ft./sec. layer on traverse 2. A blind zone is a layer whose thickness and velocity are such that first arrivals from it cannot be detected using conventional in-line geophones at discrete spacings.

The nomograms in Hawkins and Maggs, 1961 can be used to set limits on the depth and thickness of such a zone, if it exists. We find that by assuming a simple two layer case for traverse 2 (2 360 ft./sec. followed by 10 200 ft./sec. at the eastern end) we compute a depth of 30 feet normal to the bedrock surface. If we assume a hidden 6 100 ft./sec. layer we find that this could lie at a depth of 25.5 feet and have a thickness of up to 15 feet before it could be detected on the time-distance plot. A depth of 25.5 feet to weathered bedrock would be more in line with the results obtained from traverse 1.

Therefore it seems reasonable to postulate that beneath traverse 1 weathered bedrock occurs to such a thickness that unweathered bedrock cannot be detected because of the small spread size, but that this pinches out to become a blind zone under traverse 2.

This postulate is borne out by the results for traverses 3 and 4 which show a slow velocity layer of 600 to 1 200 ft./sec. (uncompacted fill) overlying at a depth of 5 to 10 ft. what is probably weathered bedrock (2 500 to 3 500 ft./sec.). A higher speed bedrock layer (c. 7 000 ft./sec.) appears below this. Note too, appearing in the weathered bedrock, the low velocity (1 480 ft./sec.) zone on traverses 3 and 4.

The resistivity depth probe shows the following distribution:

<u>Layer</u>	<u>Resistivity</u>	<u>Thickness</u>	<u>Depth</u>	<u>Interpretation</u>
1	301 ohm-m	10.5 ft.	0	Fill?
2	120 ohm-m	15.7 ft.	10.5 ft.	Natural subsoil?
3	425 ohm-m	-	26.2 ft.	Bedrock

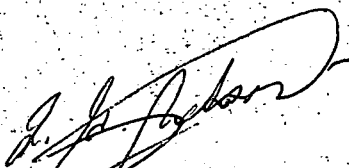
The interpretation of depth to bedrock is of the same order as that obtained for the seismic traverse and as such is acceptable. That of depth of fill is tentative only and should not be accepted without some sort of confirmation.

CONCLUSIONS

The topography of the site imposes its own limitations on the accuracy of depth determinations. However, the overall interpretation as shown in the sections in Plan No. 73-787 is thought to be reasonable. Therefore we can conclude:

- (1) that bedrock lies at depths of possibly 25 to 30 feet below the surface of the main road;
- (2) that a wedge of weathered bedrock extends from downslope pinching out towards the main road;
- (3) with the exception of a weak zone in the weathered bedrock on traverses 3 and 4 there is no major weakness in the bedrock refractor.

RGN:AM
22.11.73


R.G. NELSON
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EXPLORATION GEOPHYSICS SECTION

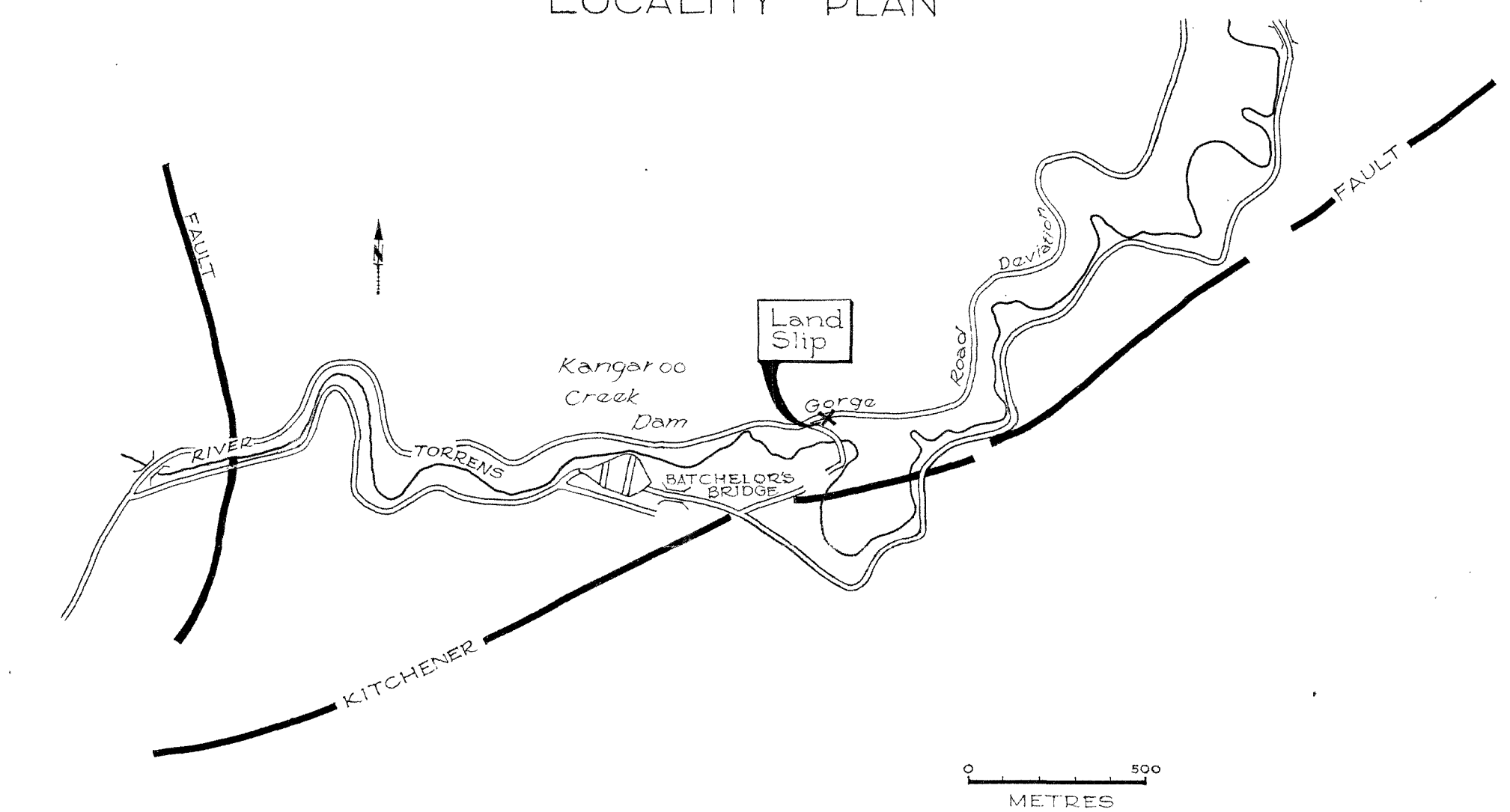
REFERENCES

Hawkins, L.V. and Maggs, D., 1961. Nomograms for determining maximum errors and limiting conditions in seismic refraction survey with a blind-zone problem. Geophysical Prospecting, 9: 526-532.

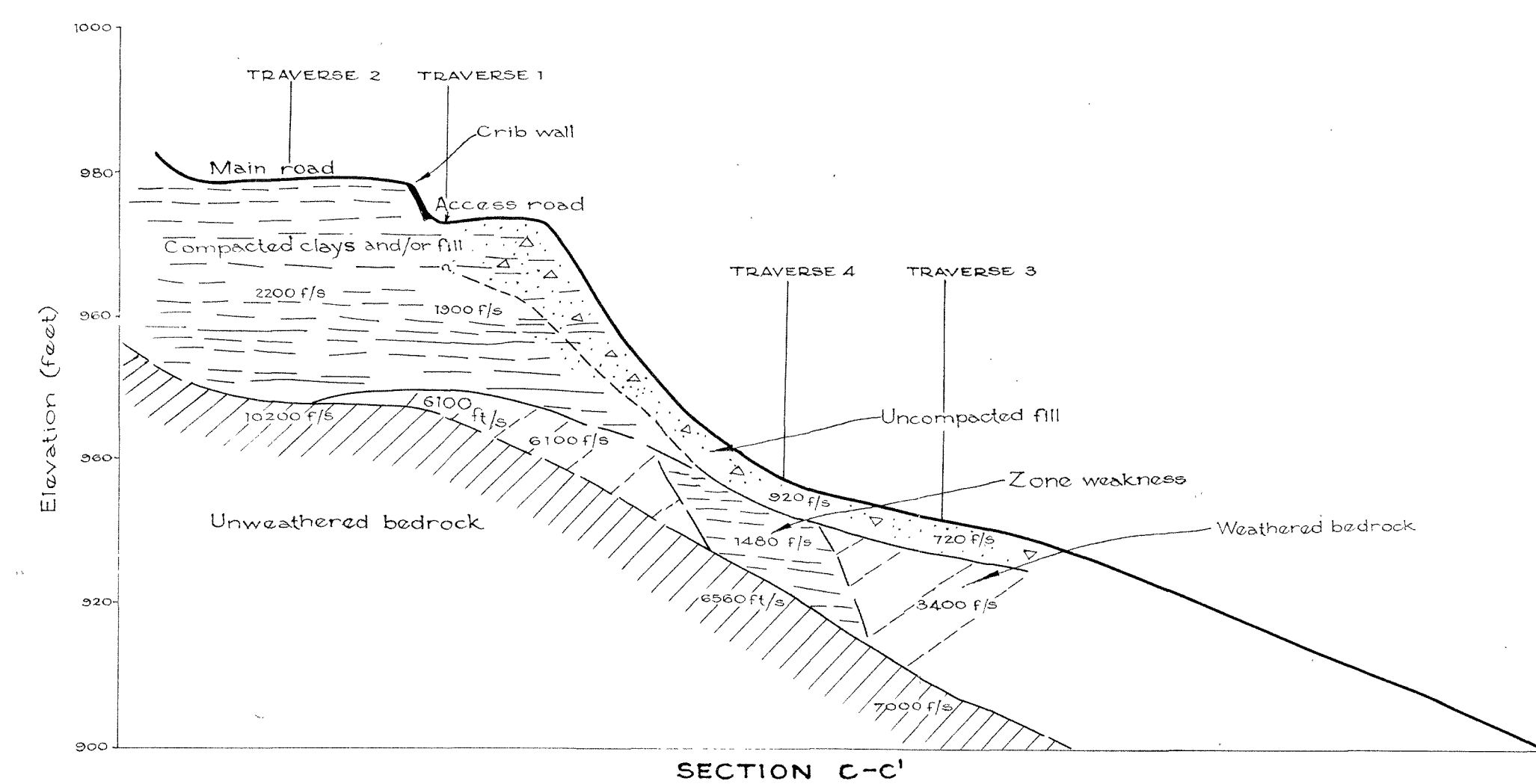
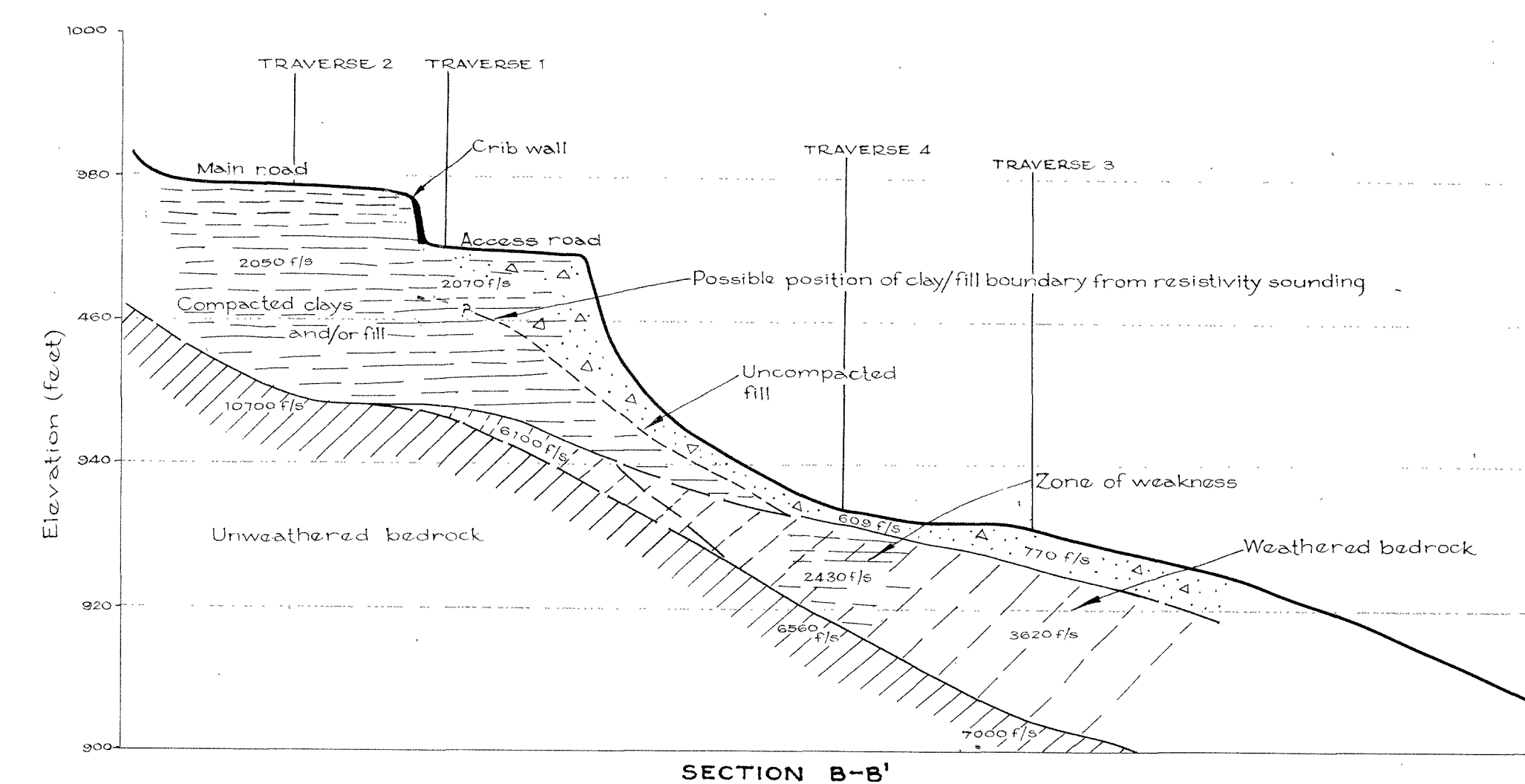
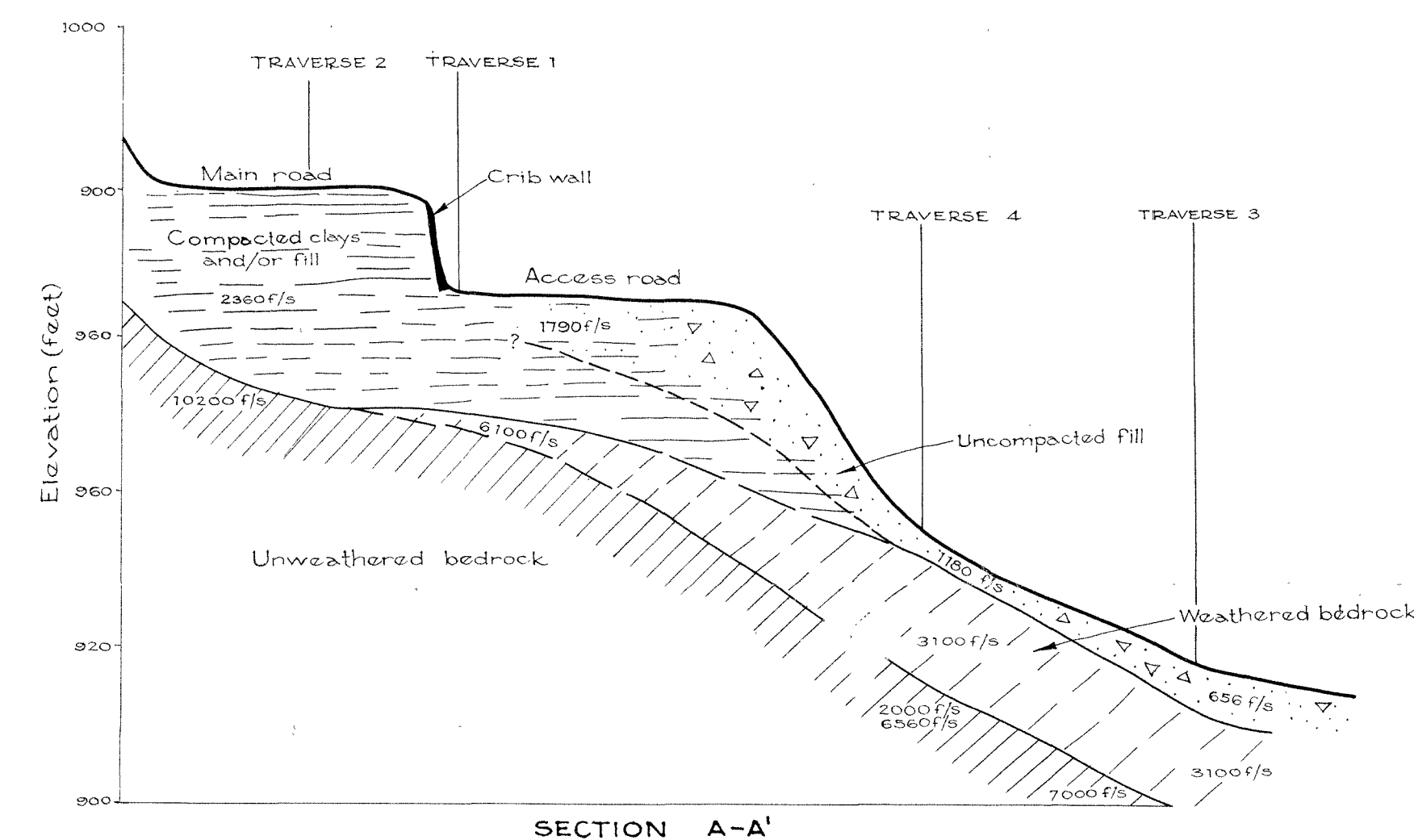
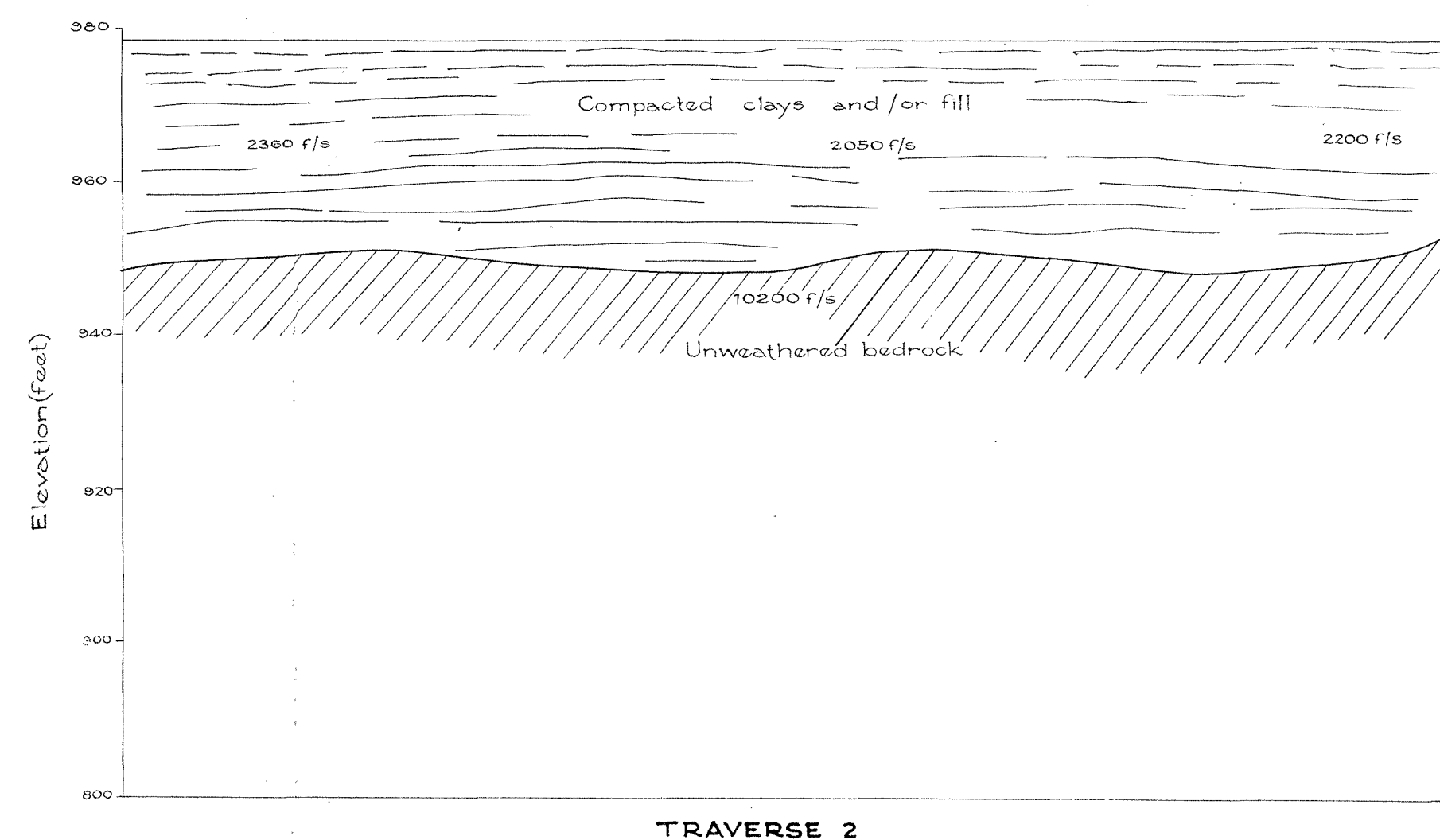
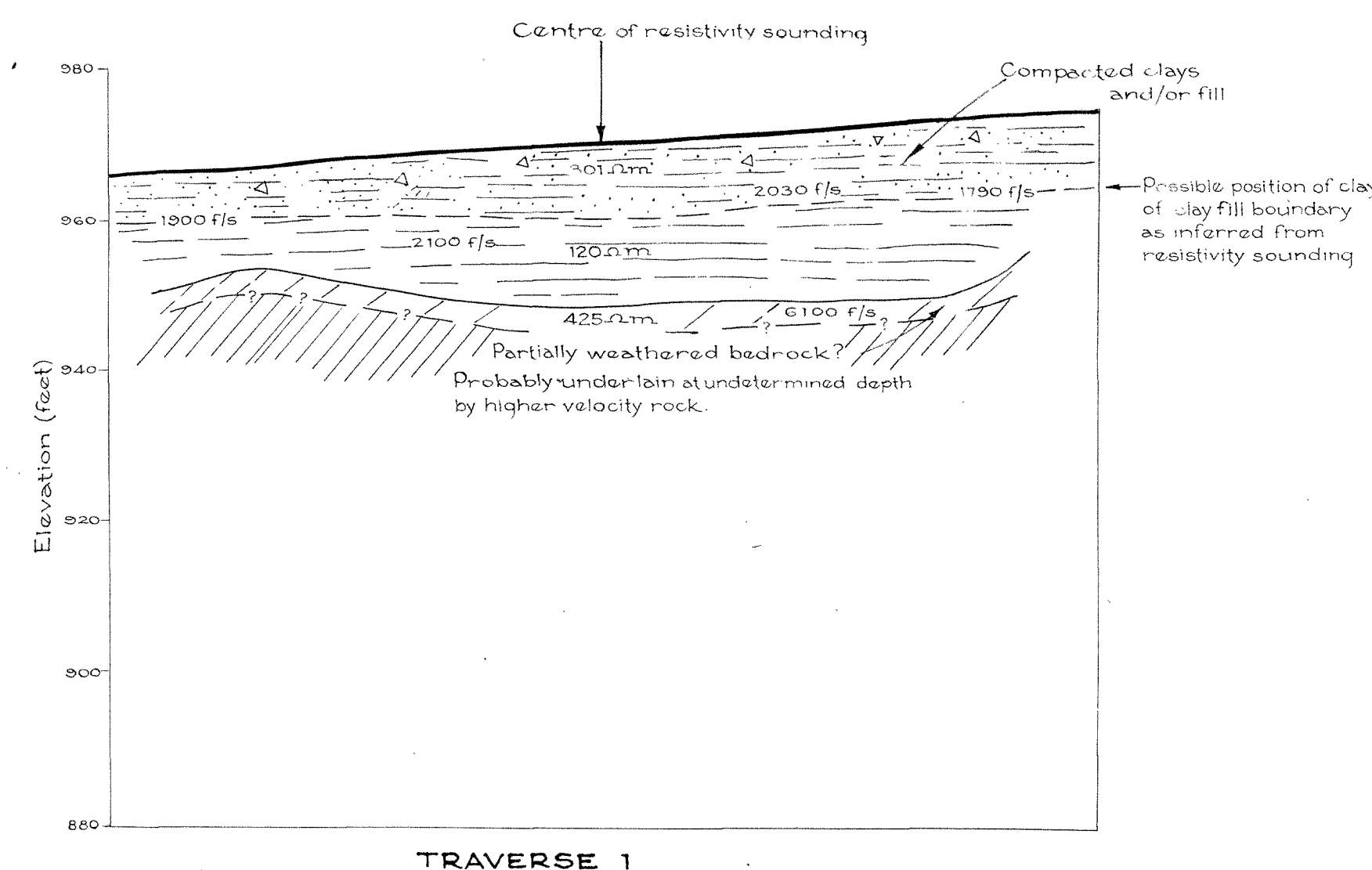
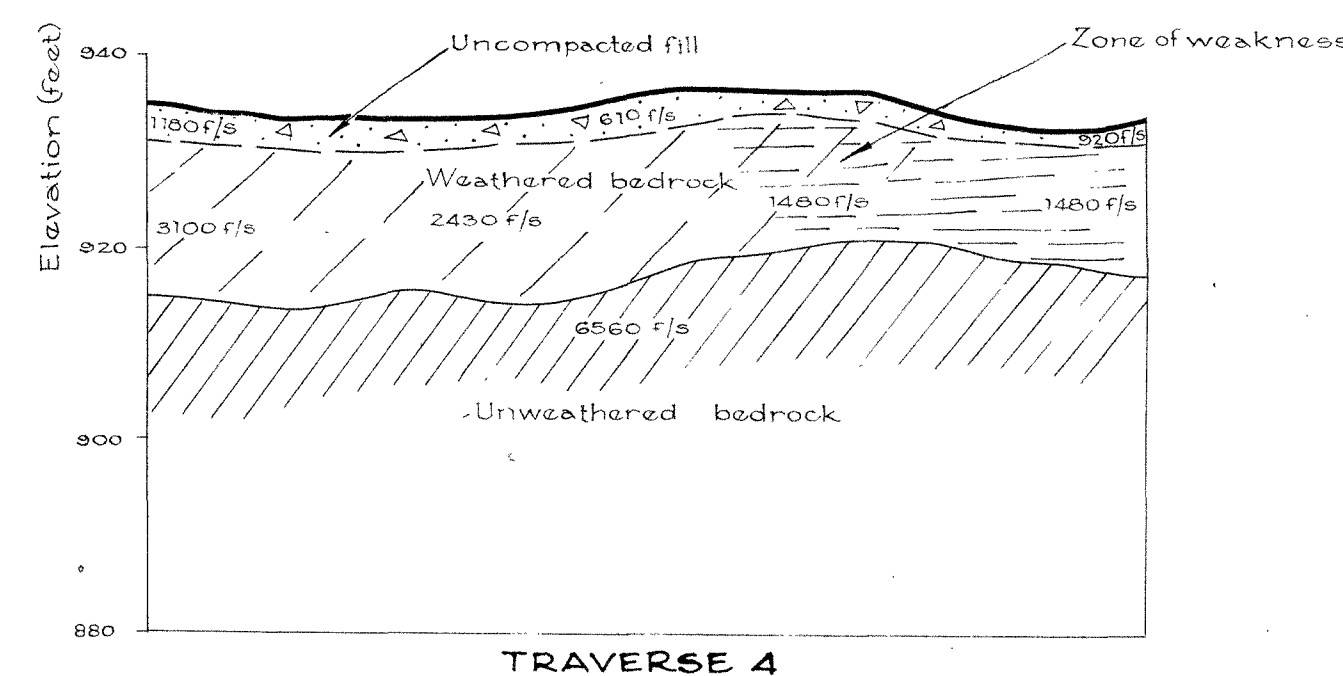
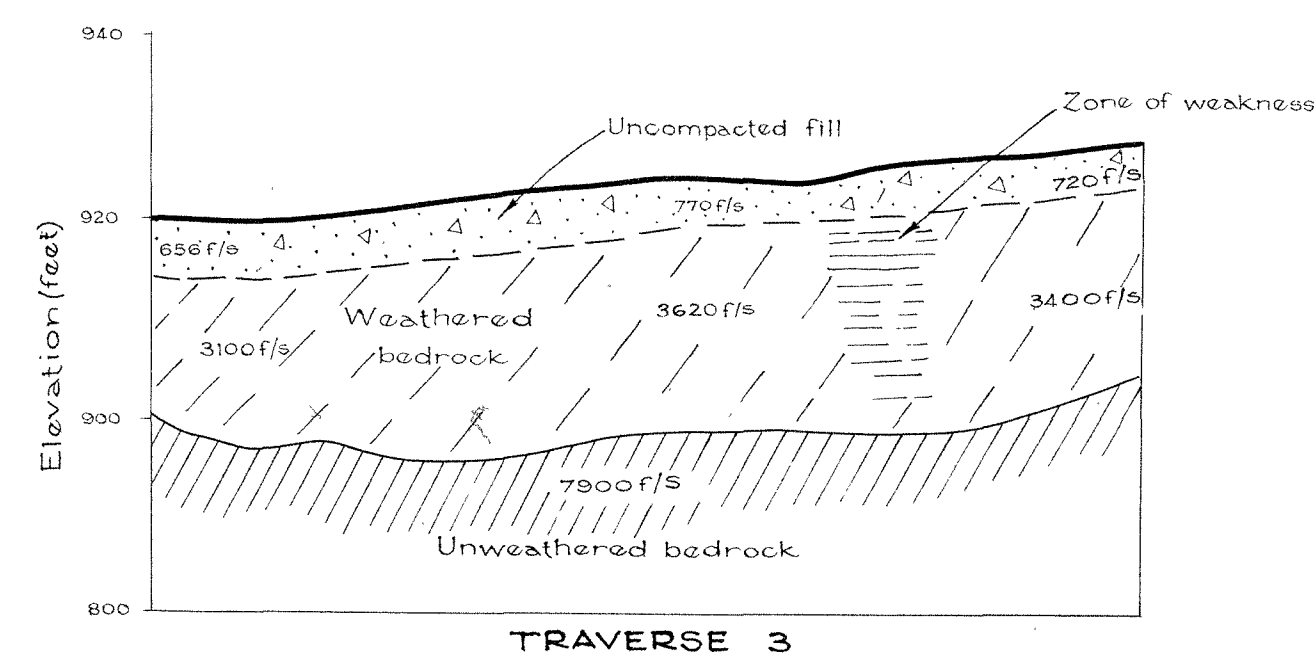


SCALE
0 10
Metres

LOCALITY PLAN



DEPARTMENT OF MINES — SOUTH AUSTRALIA			
TORRENS GORGE M.R. 272			
LAND SLIP AT CHAINAGE 8100'			
SEISMIC SURVEY — LOCATIONS OF TRAVERSES			
EXPLORATION GEOPHYSICAL SECTION	R. Nelson GEOPHYSICIST	Dm. R. N. 73-786	SCALE: As above
		Ckd. A.F.	Ha. 5/6 18
Director of Mines		Exd.	DATE: 21. 11. 73



SCALE
0 20 40 60
Feet

DEPARTMENT OF MINES — SOUTH AUSTRALIA			
TORRENS GORGE MR.272			
LAND SLIP AT CHAINAGE 8100'			
SEISMIC TRAVERSES 1-4 & SECTIONS A-A'-C-C'			
EXPLORATION	R. Nelson	Drn. R.N.	SCALE: As above
GEOPHYSICAL	Ted. G.M.	Ted. G.M.	73-787
SECTION	Ed. A.F.	Ed. A.F.	HdS/6-8
Director of Mines		Ed.	DATE: 21.11.73