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DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record No. 1969 / 86

Stapleton Creek Dam Site Geophysical Survey,

Northern Territory 1968

by

R.J. Whiteley

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SUMMARY

A geophysical survey was made at the request of the Water Resources Branch, Northern Territory to determine thickness and quality of the bedrock at Stapleton Creek. The survey showed that bedrock in the area is uniformly well consolidated and lies at a depth of about 70 feet.

1. INTRODUCTION

To improve and develop lands in the Adelaide River area the Northern Territory Administration is considering the construction of a 40-foot-high flood mitigation and irrigation dam at Stapleton Creek, some 67 miles south of Darwin (Plate 1).

At the request of the Water Resources Branch of the Northern Territory Administration the Bureau of Mineral Resources, Geology & Geophysics made a geophysical survey to determine the depth and nature of the bedrock at the dam site.

The site was surveyed in conjunction with a nearby site at Adelaide River during August and September 1968 by a party consisting of R.J. Whiteley (Party-leader), D. Tarlinton (Technical Assistant) and three field assistants provided by the Water Resources Branch. E.J. Polak visited the party as supervising geophysicist.

2. GEOLOGY

The geology of the area is described by Braybrooke (1967). Plate 2 shows the geology together with the location of the seismic traverses and resistivity depth probes. The proposed dam axis is pivoted on a low central knoll separated from higher ridges of the left bank by Stapleton Creek and alluvial flats to the north-east. To the west of the central knoll the alluvial flats rise somewhat more gradually to the hill forming the right bank.

Rocks within the dam-site area consist of phyllite, fine-grained sandstone and graded metagreywacke with a general northerly strike. On the left bank the rock is mainly phyllite with a few long, thin, fine-grained sandstone ribs within the southern limb of an anticlinal fold. The phyllite is highly weathered, brittle to soft, and very closely cleaved to finely fragmented at the surface. On the southern side of the central knoll there is a highly weathered phyllitic sequence containing moderately hard metasiltstone and fine-grained sandstone beds. Soft to moderately hard, graded metagreywacke crops out on the northern side of the knoll. The right bank consists of highly weathered steeply-dipping phyllite in the southern limb of an anticlinal fold. The alluvial cover throughout the area consists of sandy to silty clay.

3. METHODS AND EQUIPMENT

Seismic refraction method

The seismic refraction technique used is described by Dyson and Wiebenga (1957). Depths to bedrock were calculated by the 'method of differences' (Heiland, 1946, p. 548).

On most of the seismic traverses a geophone spacing of 25 feet was used. Two shots were fired at each end of the spread, one at 25 feet and one at 200 feet beyond the ends of the spread. In addition, 'weathering spreads' with a 10-foot geophone spacing and bracketing shots of 5 feet and 25 feet were used to obtain the velocities of the upper layers.

The equipment used consisted of a 24-channel refraction SIE seismograph and TIC geophones with a natural frequency of 20 Hz.

Resistivity method

Several Wenner resistivity depth probes were completed using the method described by Dyson and Wiebenga (loc. cit.). Provided care was taken to ensure good electrode contact by moistening the ground surrounding the electrode with salt water, the readings were regular and repeatable.

The instrument used was a Tellohmeter manufactured by Nash and Thompson. Resistivity measurements on water samples from Stapleton Creek were done with a Fann resistivity meter.

4. RESULTS

Seismic results

As used in this Record the term 'bedrock' refers to the deepest refractor with the highest recorded seismic velocity. The term 'overburden' refers to soil, alluvium, scree material, and partially to completely weathered rock in situ. Soil is defined as a surface layer consisting of a mixture of organic matter with other material in situ or transported.

Depths to bedrock were calculated at each geophone station and shot-point of the 'normal' spreads, whereas depths to intermediate layers were calculated at shot-points and interpolated between them. The results are shown in Plate 3. The layers encountered can be conveniently grouped according to their velocity:

Velocity	Rock type
1000-1800 ft/s	Soil
4500-5000 ft/s	Completely weathered rock <u>or</u> water-saturated sandy alluvium.
7000-10,000 ft/s	Partially weathered bedrock.
12,000-16,000 ft/s	Unweathered bedrock.

Soil forms the top layer throughout the area and is generally from 5 to 9 feet thick. On Traverses B and C and the southern end of Traverse A the alluvial cover is very thin and weathered bedrock forms the second layer almost immediately beneath the soil cover. On Traverse B, bedrock depths are all less than about 50 feet. The same is true for Traverse C except where the weathering layer thicknens to a depth of up to 100 feet beneath the hills at either end of the traverse.

The central knoll on the eastern end of Traverse C is capped by a large concrete slab. This prevented investigation of the proposed spillway site, and only a shortened traverse could be done. A 12,000-ft/s layer was encountered in the region but was too thin to be evident on the longer traverses.

On Traverses A,D,E, and F the second layer has a velocity of about 5000 ft/s. This layer could be either saturated alluvium or completely weathered bedrock. It is impossible to distinguish between the two interpretations on seismic evidence alone; but considering the geology it is probable that the former interpretation is correct on Traverses D and E and the central region of Traverse A, while the latter is more likely on Traverse F and the northern end of Traverse A.

Bedrock occurs at a depth of generally less than 70 feet on all traverses, and where alluvium is present it is generally less than 30 feet thick.

It should be noted that on Traverses D, E, and the central part of Traverse A depths are calculated below a datum and not below actual ground surface, as the topographic contour interval was too large to permit better definition of surface features.

The error in depth determination is considered to be less than ± 20 per cent. This estimate is based on experience of results in other areas of comparable geological conditions. The possibility of a fairly large percentage error in the depth of bedrock is due to many factors such as abrupt lateral change in thickness, change in water content, and steep topographic slope.

Resistivity results

The resistivity results are shown in Figures 1-3. Interpretation was done using the method described by Dyson and Wiebenga (loc. cit.).

Three layers were indicated in the interpretation. The top layer is quite thin with a high resistivity, and represents the dry soil cover. Resistivity measurements on samples of water from Stapleton Creek indicated a resistivity of about 29 ohm-metres at 20°C, which agreed fairly well with the interpreted resistivity of the second layer. Depths to the top of the bottom layer agreed quite closely with bedrock depths from the seismic results.

5. CONCLUSIONS

The seismic work shows that bedrock at the dam site is uniformly well consolidated, and no regions of low velocity indicating shear zones etc. were encountered. Depths to bedrock are generally less than about 70 feet. The 7000-10,000 ft/s weathered bedrock could prove a suitable foundation rock for the type of dam envisaged. Depths to this layer range up to about 30 feet beneath a cover of sandy alluvium, or very shallow where alluvium is not present.

The limited amount of resistivity work showed good agreement with the seismic depths to bedrock and could be used to advantage if further information is required.

6. REFERENCES

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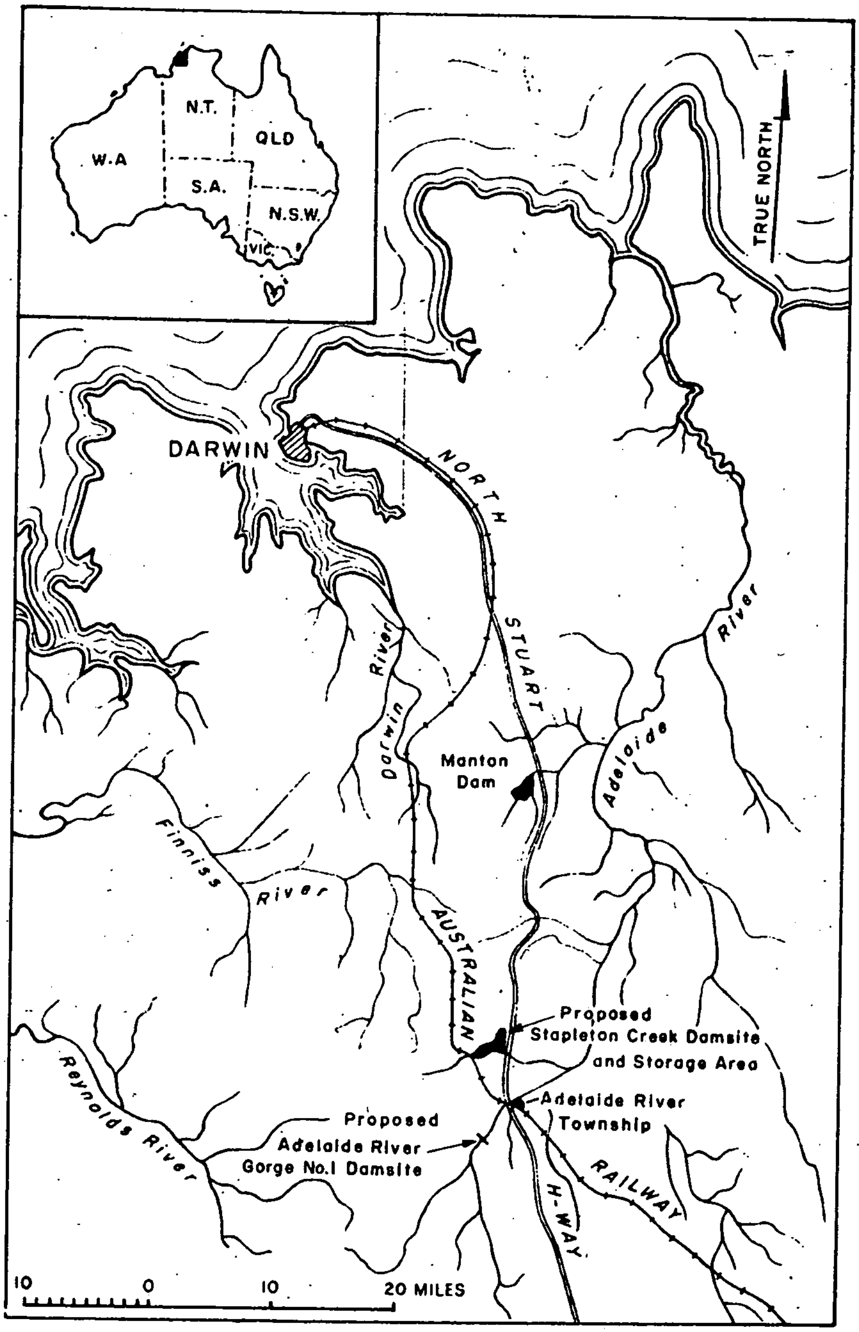
HEILAND, C.A.	1946	GEOPHYSICAL PROSPECTING. New York, Prentice Hall Inc.
DYSON, D.F. and WIEBENGA, W.A.	1957	Final report on geophysical investigations of underground water, Alice Springs, N T 1956. Bur. Min. Resour. Aust. Rec. 1957/89 (unpubl.).

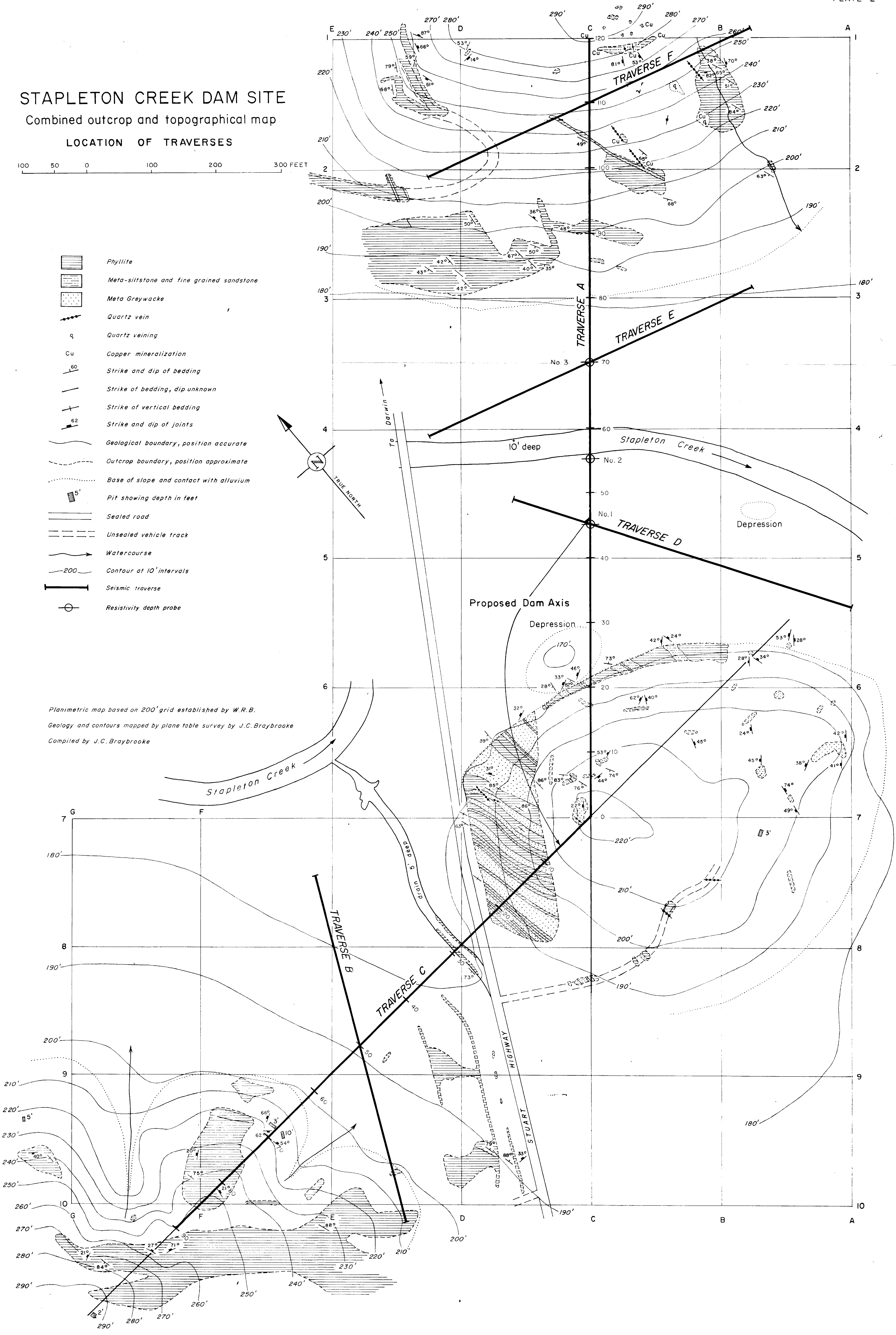
PLATE I.

Locality Map Stapleton Creek Damsite



To accompany Record 1969/86 D52/B5—26

Bureau of Mineral Resources, Geology and Geophysics. October 1967. EJ

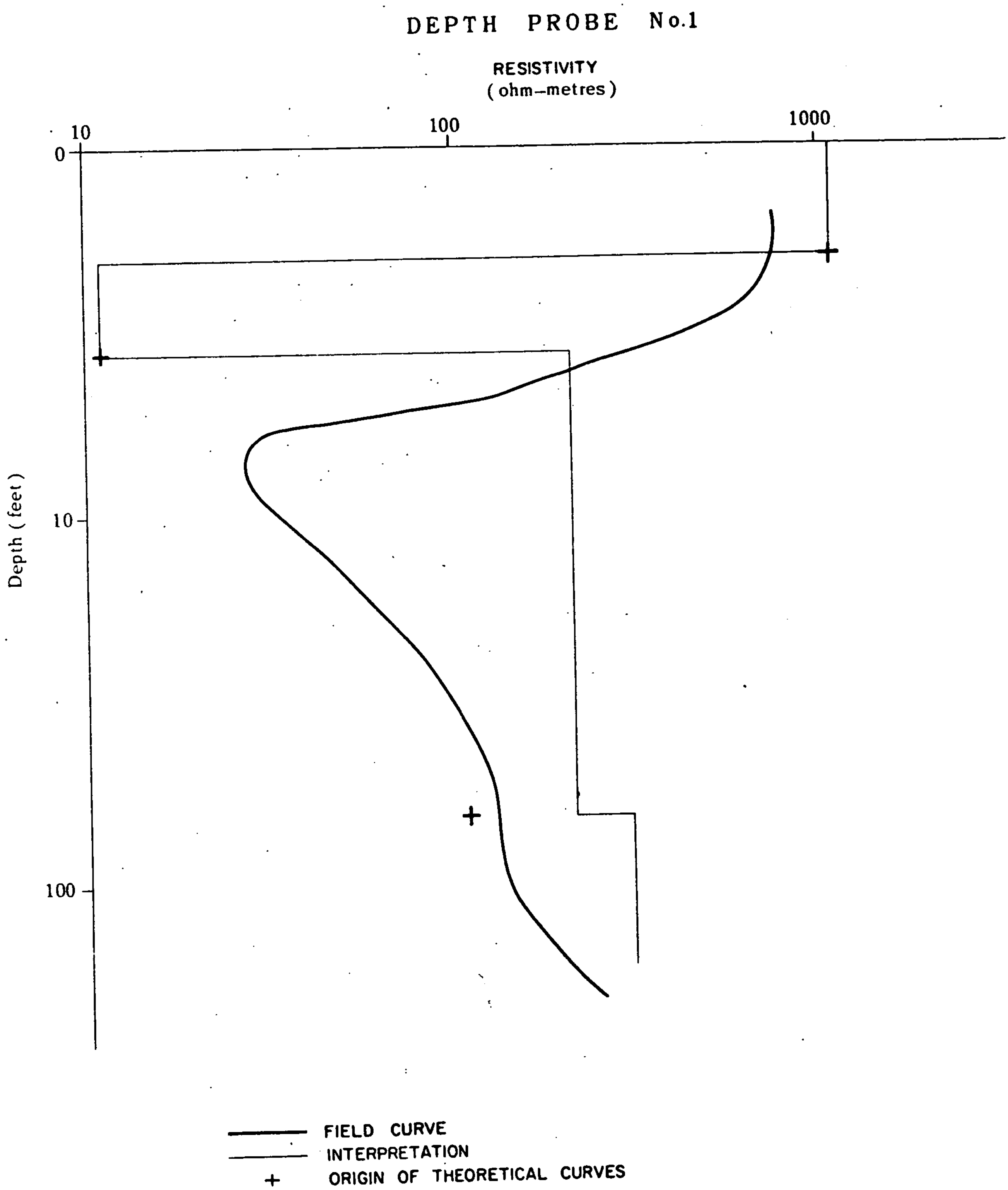


(Based on D52/A8-243)

TO ACCOMPANY RECORD No. 1969/86

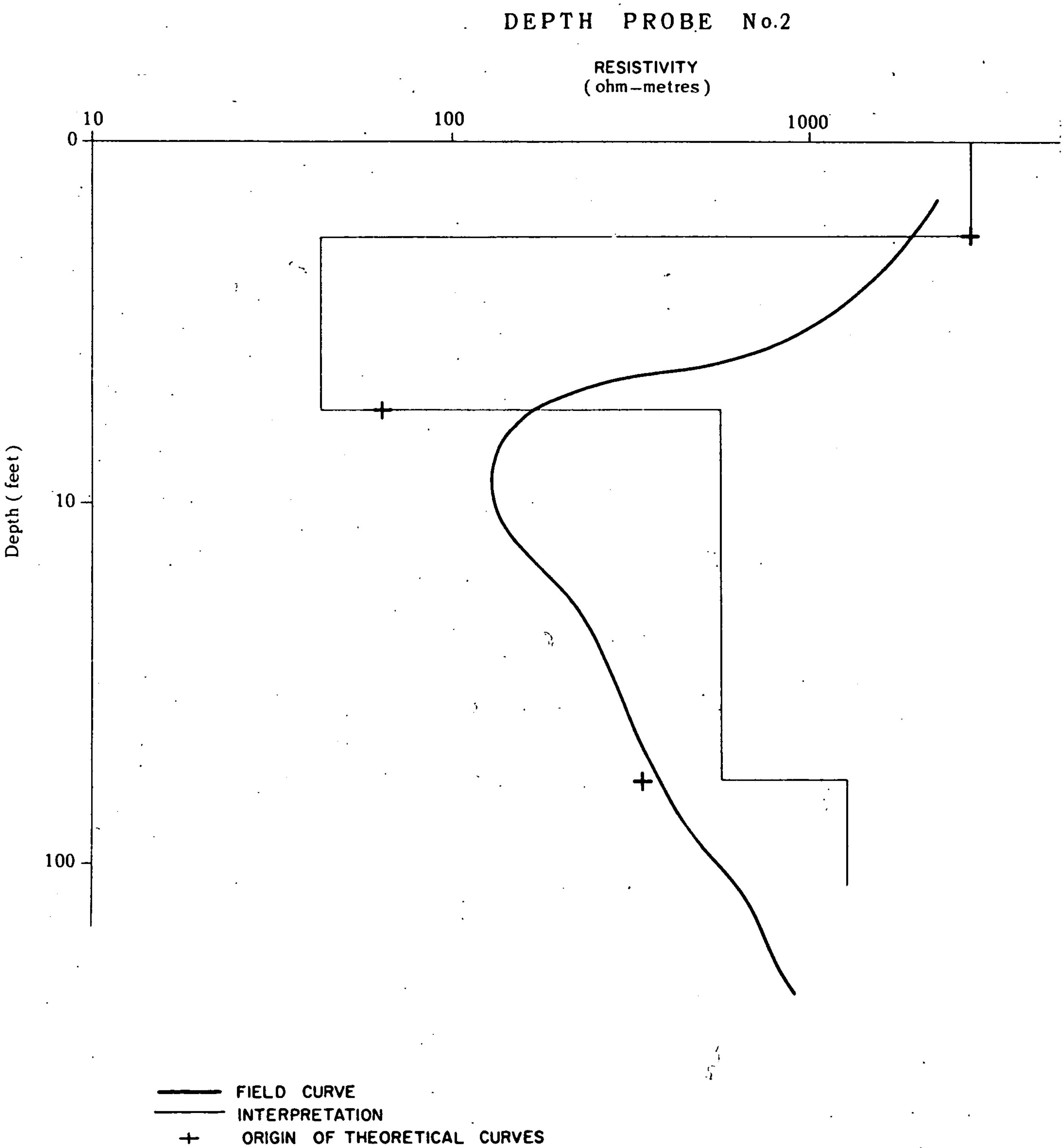
D52 / B5-19

STAPLETON CREEK, N.T. 1968



DEPTH PROBE No.1
RESISTIVITY
(ohm–metres)
10
100
1000
0
10
100
Depth (feet)
FIELD CURVE
INTERPRETATION
+ ORIGIN OF THEORETICAL CURVES

figure 2



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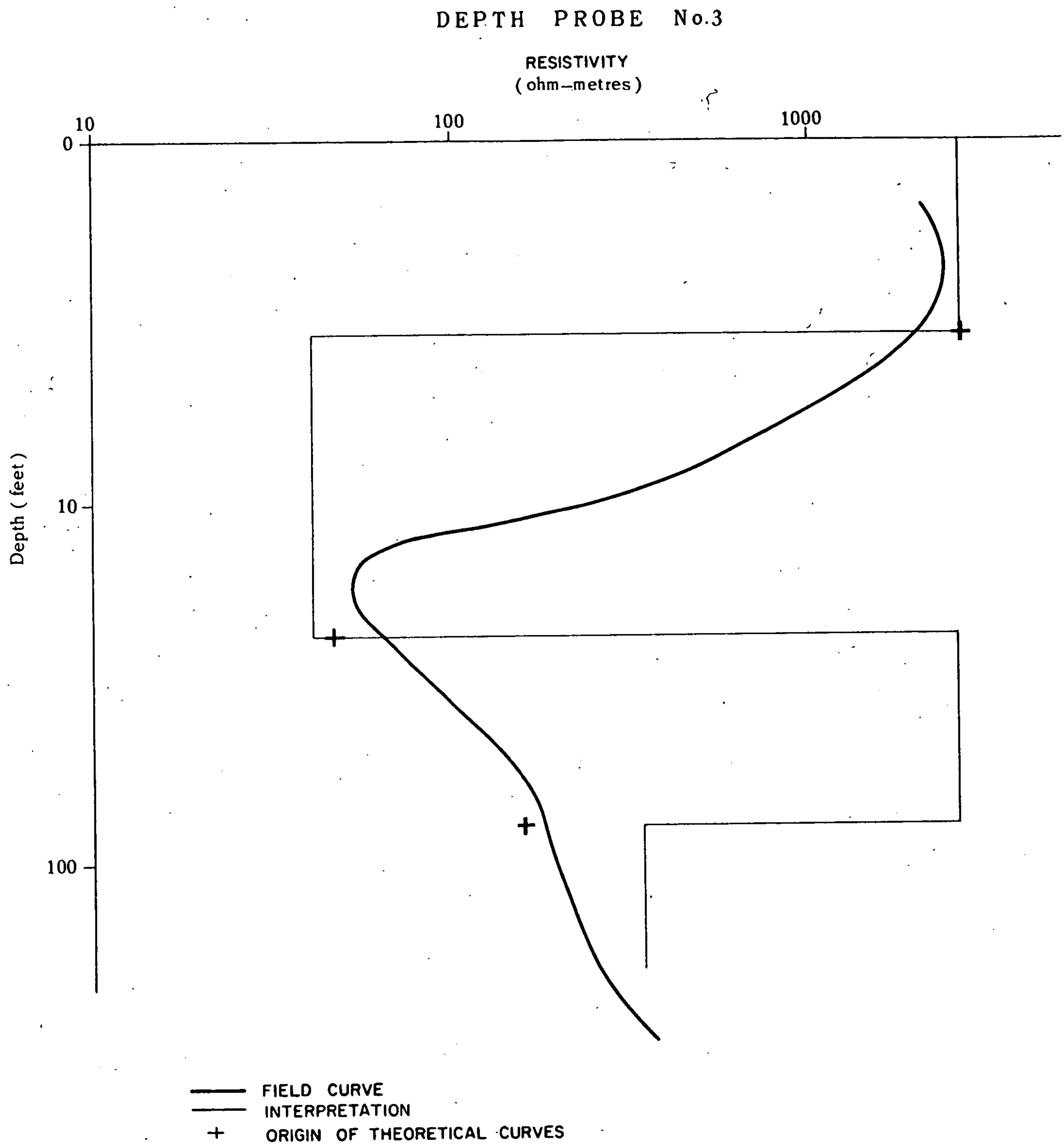
DEPTH PROBE No.3
RESISTIVITY
(ohm–metres)
10
100
1000
0
10
100
Depth (feet)
FIELD CURVE
INTERPRETATION
+
ORIGIN OF THEORETICAL CURVES