1968/9

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GEOLOGY AND GEOPHYSICS

RECORDS:

RECORD NO. 1968/9

DON RIVER DELTA SEISMIC REFRACTION SURVEY, QUEENSLAND 1965: RE-INTERPRETATION OF CONTRACTOR'S DATA

by

L. KEVI, E.J. POLAK and W.A. WIEBENGA

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SUMMARY

A seismic refraction survey was made in 1965 by Ground and Marine Geophysics Ltd in the Don River Delta, Bowen, Queensland, in order to determine the amount of water available for irrigation. The data submitted by the contractor have been re-analysed by the BMR; the results of the re-analysis are presented as sections along seismic traverses and as contour plans of the thickness of alluvium and the depth to unweathered bedrock.

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1. INTRODUCTION

A survey was carried out in May 1965 by Ground and Marine Geophysics Ltd, Bournemouth, England, for the Department of Mines, Queensland, to determine the position of the water table and the thickness of the alluvium in the Don River Delta, near Bowen, Queensland. From the data of the survey the pumping capacity of the area will be calculated giving the amount of water available for irrigation of market gardens.

The results of the survey were submitted to the Department of Mines, Queensland, and subsequently to the Bureau of Mineral Resources, Geology and Geophysics for re-examination. These notes are the results of this re-examination.

2. COMMENTS ON METHODS

In the survey a seismic refraction method was used. The shooting procedure adopted by the contractor (Ground and Marine Geophysics Ltd) differed from the one used by the BMR. In their spread arrangement a standard spacing of 33 feet between geophones was used and only two shots were fired per geophone spread. These shots were placed 15 to 20 feet from each end of the spread, sometimes offset from the line of the spread.

Although this method speeded up the survey considerably, it introduced severe limitations to the interpretation of the seismic data and accuracy of results, because:

1. The determination of the thicknesses and velocities in near-surface layers was made impossible by lack of weathering spreads with a geophone spacing of 10 feet. The determined velocities for the upper layers are only approximate and therefore the depths to the water table and the bedrock are only approximate too.

2. Using only a single shot at each end of the spread, instead of at least two shots at different distances off the end of the spread, resulted in an ambiguity in the interpretation. It was often not possible to distinguish between a dipping bedrock refractor and the refractors above the bedrock.

3. Geophone spreads were treated as separate units. There were no common geophones in successive spreads, and hence control on continuity of layers was lost. Additional gaps in traverses were introduced in places where access was difficult, resulting in zones without data.

3. RE-ANALYSIS OF SEISMIC DATA

Time-distance curves were plotted from the data. Four main formations were indicated:

1. Near-surface material, with seismic velocities of 1000 to 2500 ft/s: soil, clays, and sands above the water table.

2. Alluvium with seismic velocities of 2500 to 6500 ft/s (see Plate 1), which may be subdivided as follows:

   2500 to 4000 ft/s: clayey and silty to sandy alluvium.
   4000 to 5300 ft/s: silty to sandy or gravelly alluvium.
   5300 to 6500 ft/s: compacted or old alluvium, possibly with gravel or boulders; alternatively very weathered bedrock.

The above classification was chosen to provide a basis to select drilling targets. Drill holes placed in alluvium of 4000 to 5300 ft/s velocity are expected to yield more water than in any other formations.

3. Highly weathered to unweathered bedrock with velocities between 5300 and 11,000 ft/s. The expected water yield is moderately low to very low (seepage water?) except perhaps in shear or fault zones.

4. Unweathered bedrock, with seismic velocities in excess of 15,000 ft/s: igneous or metamorphic rock; will yield practically no water except possibly in shear or fault zones.

The results of the re-analysis are shown in Plates 1 to 3.

4. INTERPRETATION

The Don River was built up by the old river on a similar pattern as the Burdekin River Delta. The Don River (Plate 2) was flowing into the sea south of traverse 7. The main channel was flowing east of an island (stations 702 and 707) only partly covered in the survey. When this channel was filled, the river swung intc a northerly direction, splitting into branches, crossing traverse 6 near stations 602/3 and 606. The branches meet again to flow through station 506. North of this point the main channel goes to station 410, but a subsidiary channel goes north-east to cross traverses 4 (stations 407) and 3 (station 308) to flow to sea. At station 410 one of the old channels goes west, deflected by an island indicated on traverse 1. The other channel passes station 314 and then splits again to reach the sea near station 202. The main channel flowed into the sea, passing stations 205 and 104.

The direction of flow of the river was and is controlled by a pattern of faults and shear zones indicated by zones of deep weathering (Plate 3), whose general directions are south-west along stations 104, 209, and 414 and on a parellel zone along stations 302, 501, and 704.

5. CONCLUSION

The channels of the river older than the present one are indicated by bedrock and alluvium thickness contours. The most promising formation to yield large quantities of water has a seismic velocity of between 4000 and 5300 ft/s. Hence, drilling targets for water should be located in this formation.

6. COMMENTS ON PREVIOUS INTERPRETATION

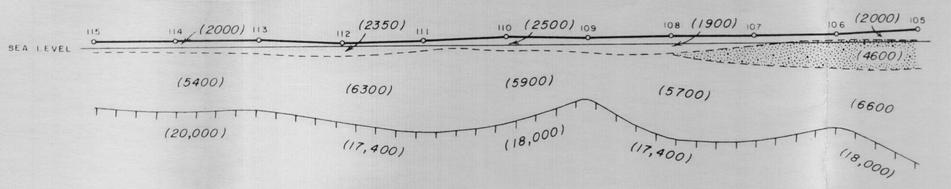
In addition to the comments given in the Introduction, the following may be noted in relation to the report by Ground and Marine Geophysics Ltd.

1. "The plate showing the bedrock contours (and also paragraph 3, page 4) indicates a pattern of faults". The basis for this interpretation is not apparent to us.

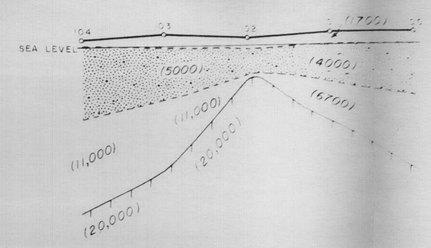
2. "The 'water table' plate shows areas of varying degrees of salinity, deduced from seismic velocities." To our knowledge, it is not possible to use seismic velocity measured in the ground as a salinity criterion. In unconsolidated, sandy formations the ground water level may be marked by a 5000 ± 500 ft/s velocity seismic refractor, and this can on occasions be used to detect the ground water level seismically.

3. Further, exception must be made to the last but final sentence in the report which states: "The nature of the bedrock refractor does not anywhere indicate the existence of a weathered bedrock surface between it and the overlying sediments." We found a range of refractor velocities between 5300 and 11,000 ft/s, which can, and in some instances should be, interpreted as velocities in highly weathered to moderately weathered bedrock.

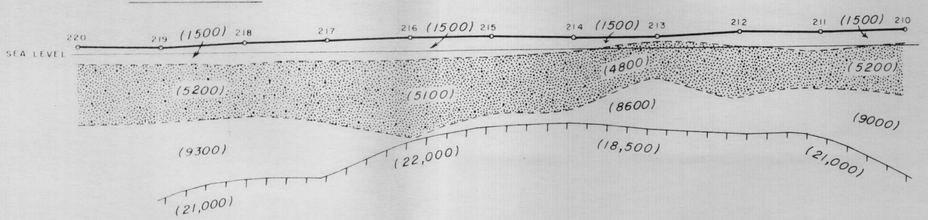
TRAVERSE 1



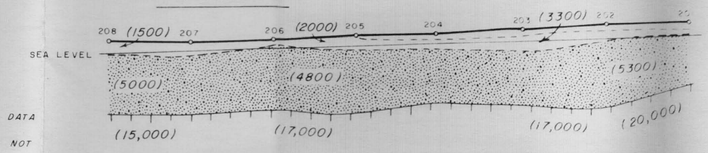
TRAVERSE 1



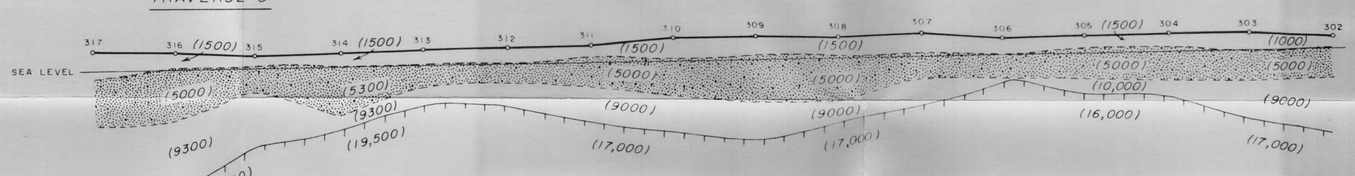
TRAVERSE 2



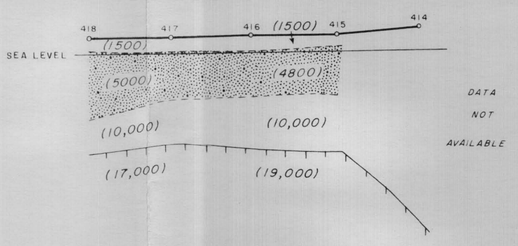
TRAVERSE 2



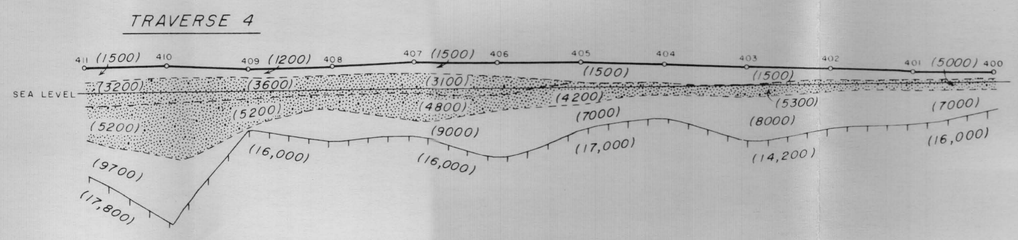
TRAVERSE 3



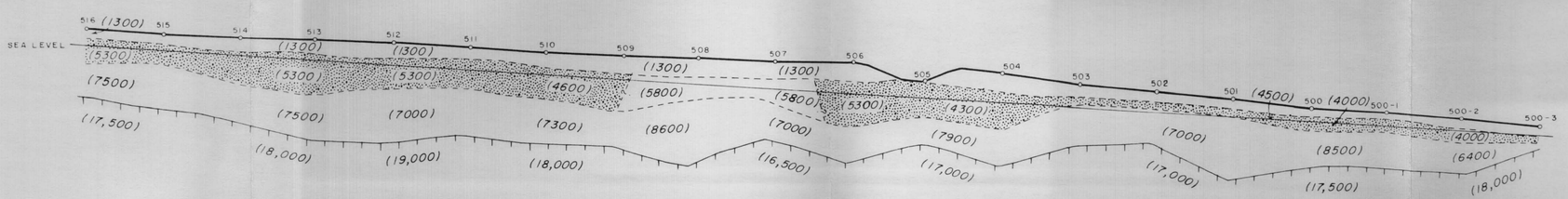
TRAVERSE 4



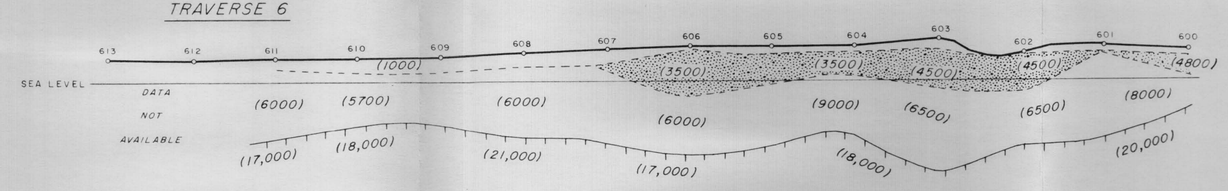
TRAVERSE 4



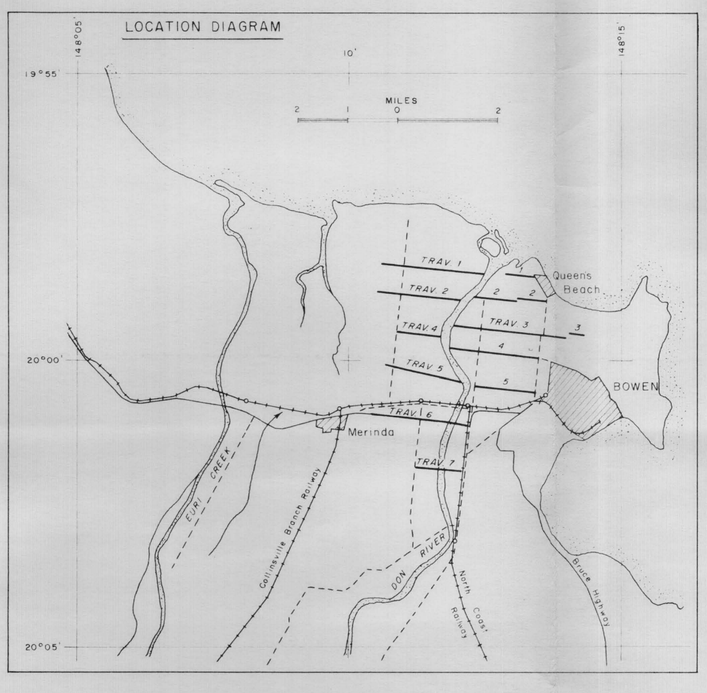
TRAVERSE 5



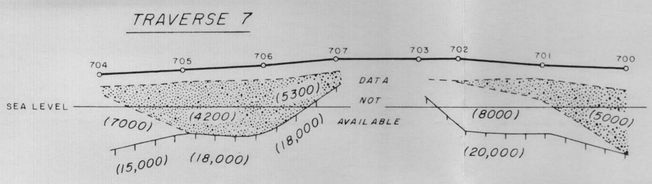
TRAVERSE 6



LOCATION DIAGRAM



TRAVERSE 7



LEGEND

500 — Station number

(1000) — Seismic velocity (ft/s) in formation

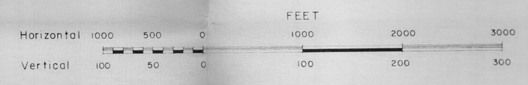
Top of bedrock

Alluvium

INTERPRETATION OF SEISMIC VELOCITIES IN GEOLOGICAL TERMS

Velocity Range (ft/s)	Geological Equivalent
1000 to 2500	Near surface soils and clays
2500 to 4000	Clayey, silty to sandy alluvium
4000 to 5300	Silty to sandy or gravely alluvium
5300 to 6500	Possibly old, compacted alluvium
5300 to 11,000	Highly weathered to unweathered bedrock
15,000 to 20,000	Unweathered bedrock

Note. The positions of the sea level lines correspond to the positions of the traverses as shown on Plates 2 and 3



RE-INTERPRETATION OF THE 1965 DON RIVER REFRACTION SURVEY, QUEENSLAND 1967
SEISMIC CROSS-SECTIONS

TO ACCOMPANY RECORD No. 1968/9

F55/B5-3

2" BINDING MARGIN

Old alluvium
or weathered rock

DON — RIVER

North Coast Railway

Approx True North

CONTOURS OF
ALLUVIUM THICKNESS

LEGEND

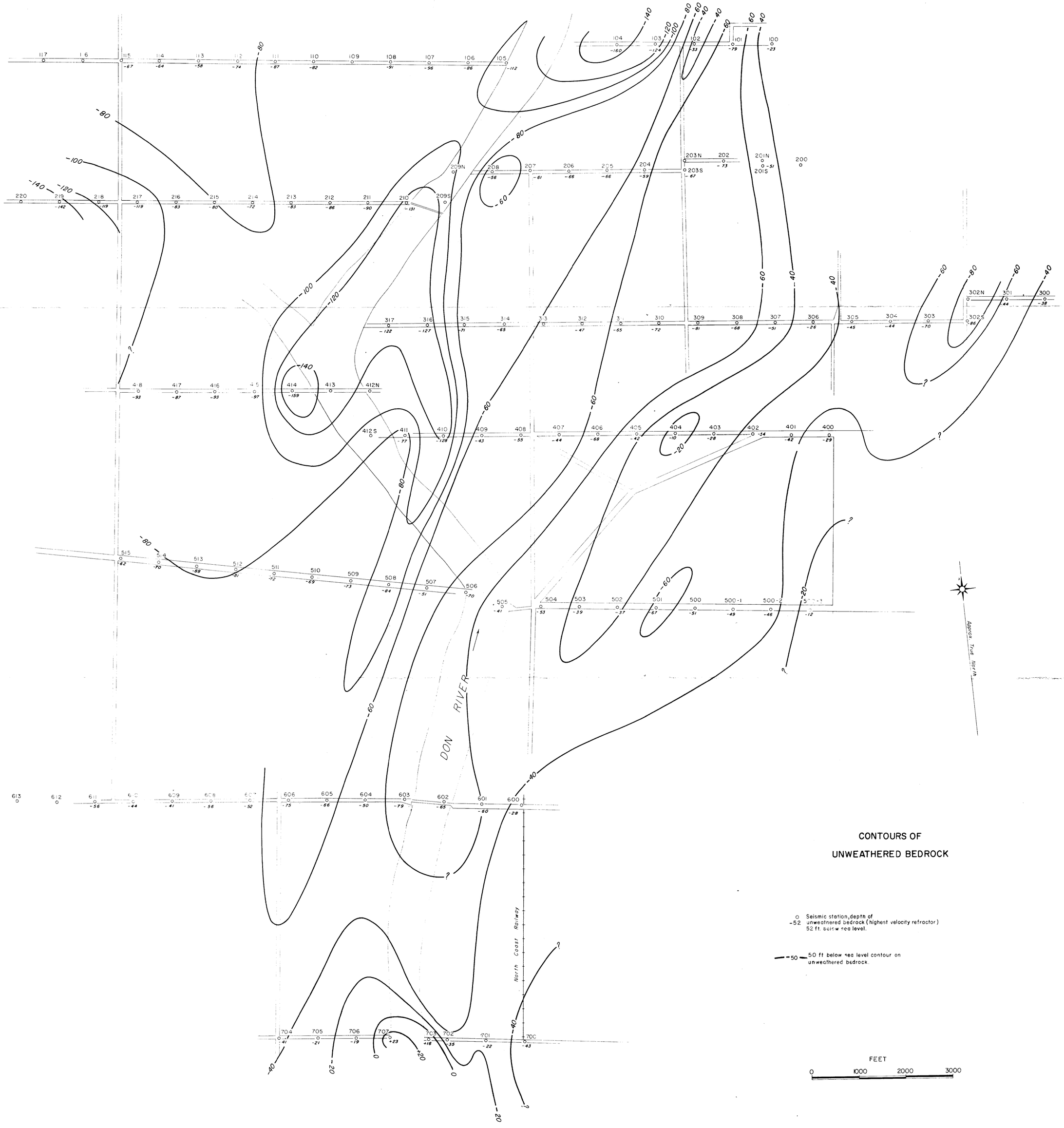
- 40 — Thickness contour of alluvium
- 706 / 20 — Station number, and depth to bottom of alluvium in feet
- Subsurface water-divide
- Approximate subsurface channel

FEET

1000 0 1000 2000 3000 4000

Contour interval 20 feet

TO ACCOMPANY RECORD No. 1968/9


DON RIVER
North Coast Railway
Approx. True North
CONTOURS OF
UNWEATHERED BEDROCK
Seismic station, depth of unweathered bedrock (highest velocity refractor) 52 ft. below sea level.
50 ft below sea level contour on unweathered bedrock.
FEET
0
1000
2000
3000