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AND GEOPHYSICS

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Record 1972/59

GEOLOGICAL INVESTIGATIONS OF PROPOSED SITE FOR RESERVOIRS 6A and 6B, BELCONNEN, A.C.T.

1971

by

J.A. Saltet

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SUMMARY

A geological investigation was carried out by officers of the Geological Branch of the Bureau at the proposed sites for Reservoirs 6A and 6B in Belconnen, A.C.T. (Figure 1).

The rock* underlying the sites is a rhyodacite of late Silurian age. Possible slate inclusions may be found during excavation. Reservoir 6A (stage 1) has a fairly thick soil* cover (generally 2-7 feet)** and deep weathering profile (fresh rock commonly 50 feet below surface). Reservoirs 6A (stage 2) and 6B have less soil cover and outcrops are numerous in their areas.

In outcrop the rhyodacite is generally slightly weathered but under soil cover weathering is greater and the rock ranges from highly to slightly weathered.

12 augerholes were drilled, mainly at the site of 6A (stage 1), to investigate the soil cover. They confirm the results of the seismic survey by Hill (1971).

Water was struck in one of the augerholes at 4 feet depth. The water is believed to be in a perched aquifer; the main groundwater level is probably deeper.

* The terms 'soil' and 'rock' are used in the engineering sense in this report. 'Soil is a natural aggregate of mineral grains that can be separated by such gentle mechanical means as agitation in water. Rock on the other hand is a natural aggregate of minerals connected by strong and permanent forces' (Terzaghi & Peck, 1969). Rock cannot normally be excavated by manual methods alone.

** The Bureau commenced conversion to the Metric System of measurements in 1970. British units are used in this report in conformity with other elements of the project but may be converted using the following factors:

1 inch = 25.4 mm
1 foot = 30.5 cm.

INTRODUCTION

At the request of the Commonwealth Department of Works, officers of the Bureau investigated three proposed reservoir sites in the Belconnen Area: the sites are 6A (stages 1 and 2), and 6B. They are on the northern slope of the hill on which the Rogers Trigonometric Point is situated, hereinafter called Rogers Hill.

The geological investigations included a study of the rock, groundwater conditions, and general slope stability. Twelve augerholes were drilled to study the depth and nature of the overburden. J.R. Kellett assisted in the soil study.

A seismic refraction survey was carried out by officers of the Geophysical Branch of the Bureau. A report on the survey is available in Record form by P.J. Hill (1971). Hill's report should be read in conjunction with this report.

GENERAL GEOLOGY AND PHYSIOGRAPHY

Rock at the reservoir sites, Rogers Hill, and the immediate environs, is a rhyodacite of late Silurian age: it is tentatively correlated with the Deakin Volcanics. A report on the geology of the area is being compiled by G.A.M. Henderson (in prep.) for issue in the Bureau's Record Series.

No evidence of bedding or flow structures was found in the area. A slate lens, striking 055° and cropping out 250 feet west of the centre-line of reservoir 6A (stage 1), may indicate that the volcanics have the same trend. The dip of the slate inclusion could not be determined; the main cleavage and joint direction in the rhyodacite in northeast and vertical; it is parallel to the strike of the slate.

The Reservoir sites are on the higher slopes of the northern face of Rogers Hill which stands about 350 feet higher than the surrounding plains. Reservoir 6A (stage 1) lies in a gully with thick soil cover (2-7 feet; reservoir 6A (stage 2) and 6B are on the flanks of the hill, where little soil cover is present and outcrops are numerous.

ENGINEERING GEOLOGY

Foundation Rock

Lithology: The rhyodacite on the reservoir site has a dark greenish grey groundmass. In the groundmass are phenocrysts of quartz (up to 10 mm), feldspar (up to 5 mm), and ferro-magnesium minerals (up to 5 mm). The dark minerals were possibly amphiboles, now altered to micas. Epidote veins are common.

The slate is a soft yellowish brown rock with a pronounced cleavage. It was not seen on the reservoir sites but may be found during excavation.

Degree of weathering: In outcrop the rhyodacite is generally slightly weathered. Where covered with soil it may be highly weathered.

If slate is present on the reservoir sites, it will be found to be more weathered than the surrounding rhyodacite.

Degree of fracturing: In outcrops the rhyodacite does not appear highly fractured and is generally harder and more resistant to weathering than the rock under soil cover; a higher degree of fracturing may be expected in areas without outcrops.

The rock in the reservoir floors varies considerably. The rock at floor level at reservoir 6A (stage 1) has velocities mainly between 4600 and 5200 feet/sec, at 6B generally between 5200 and 6200 feet/sec. The rock at floor level at reservoir 6A (stage 2) shows more variation: velocities between 4500 and 9700 feet/sec occur. These differences in elastic properties could increase the risk of damage in case of major earth tremors. The frequency and magnitude of earth tremors in the Canberra region are, however, very low (generally magnitude does not exceed 3.5 on the Richter scale; most recorded tremors had much lower magnitudes).

As Hill concludes, the variable bearing capacity of the final near-surface material in the reservoir floors may cause irregular settlement. It is recommended that a site inspection be made by a geologist prior to the construction of the foundations.

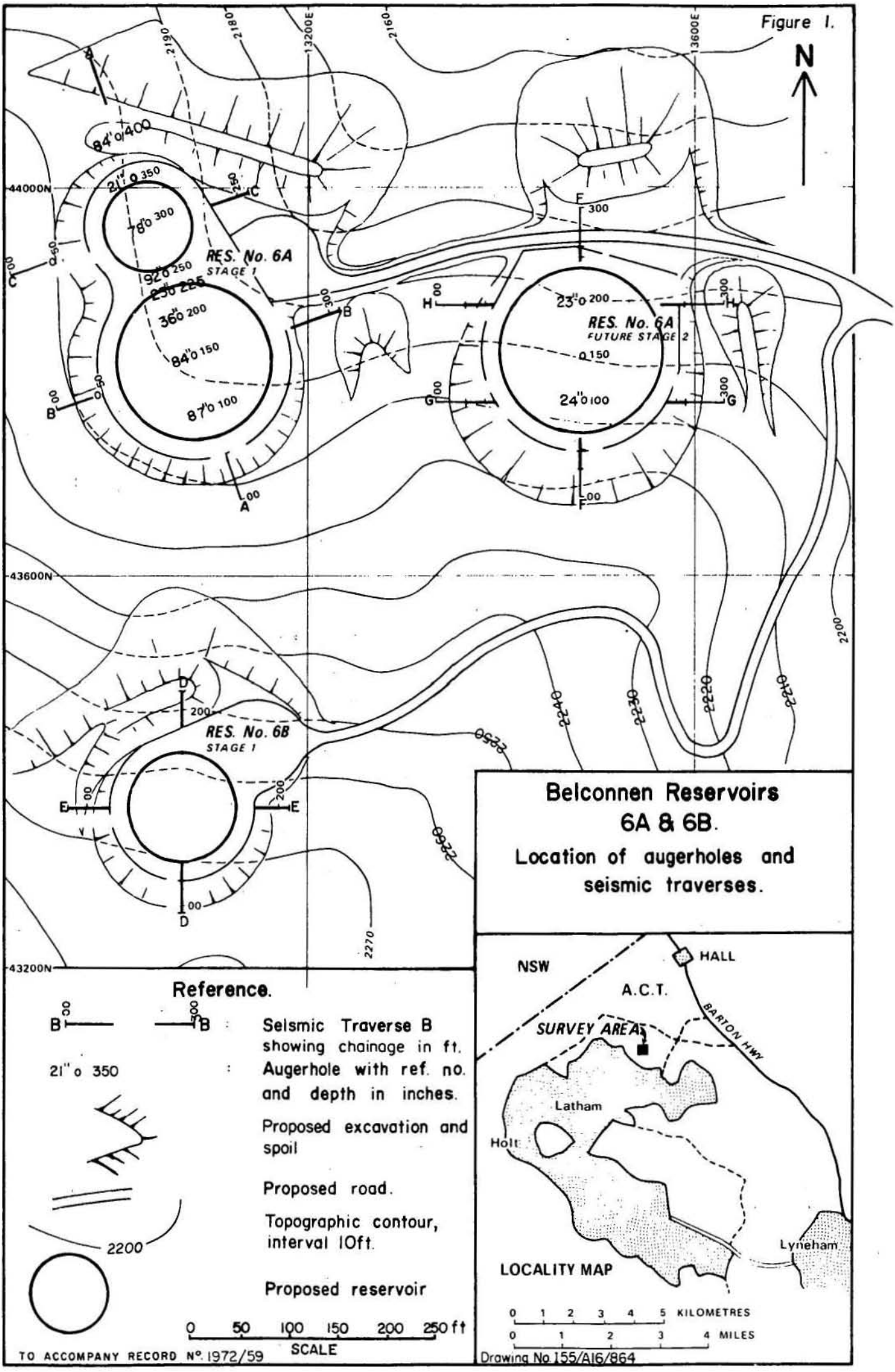
Soil cover

To investigate the depth and nature of the overburden 12 augerholes were drilled with a Proline, Type J (manual drawdown) power auger (Figure 1). 6 holes were drilled with a split-tube undisturbed sampler until completely weathered bedrock was reached: below this level augering only was carried out. The 6 remaining holes were augered only. Drilling ceased when penetration was very slow or impossible; this took place in highly weathered rock.

The augerholes were drilled along the seismic traverses, and have a reference number indicating traverse and chainage, e.g. Augerhole A400 was drilled on Traverse AA at chainage 400.

Site 6A (stage 1) has the thickest soil cover; it is situated in a watercourse. Sites 6A (stage 2) and 6B have little soil cover and rhyodacite crops out over most of the area.

Figure 1.



Belconnen Reservoirs 6A & 6B.

Location of augerholes and seismic traverses.

Drawing No. 155/A16/864

Reference.

B 00 — 300 B : Selsmic Traverse B showing chainage in ft.

21" o 350 : Augerhole with ref. no. and depth in inches.

Proposed excavation and spoil

Proposed road.

Topographic contour, interval 10ft.

Proposed reservoir

0 50 100 150 200 250 ft
SCALE

TO ACCOMPANY RECORD No. 1972/59

The soil shows little lateral variation: dark brown silt, forming the topsoil, is generally less than 4 inches thick. Under it is a layer of pale brown sandy silt up to one foot thick. Completely weathered rhyodacite underlies the silt, and becomes less weathered with increasing depth. Heavy dark red clay is found within the weathered bedrock and may represent fracture zones, where the degree of weathering is greater than in the surrounding rock. Small traces of dark red lean clay are found in places immediately above the weathered bedrock. This could represent a buried soil horizon (B horizon).

Figure 2 gives the logs of the augerholes in which undisturbed sampling was carried out, and Figure 3 shows a generalized soil profile.

Depth of penetration and the nature of the overburden, observed when augering, confirm the interpretation of the seismic survey given by Hill (1971) (Plate 1). His report also discusses suitable excavation methods and the nature of the reservoir floors.

Slope stability: Reservoirs 6A (stage 2) and 6B are unlikely to present any problems in this regard, since the thickness of the overburden is small and the slopes are gentle. On the western side of Reservoir 6A (stage 1) slightly steeper slopes and a thicker overburden are present. During excavation attention should be given to the slope stability in this section, especially during wet weather, when clay layers may provide lubricated surfaces upon which the overburden could slide.

Hydrology

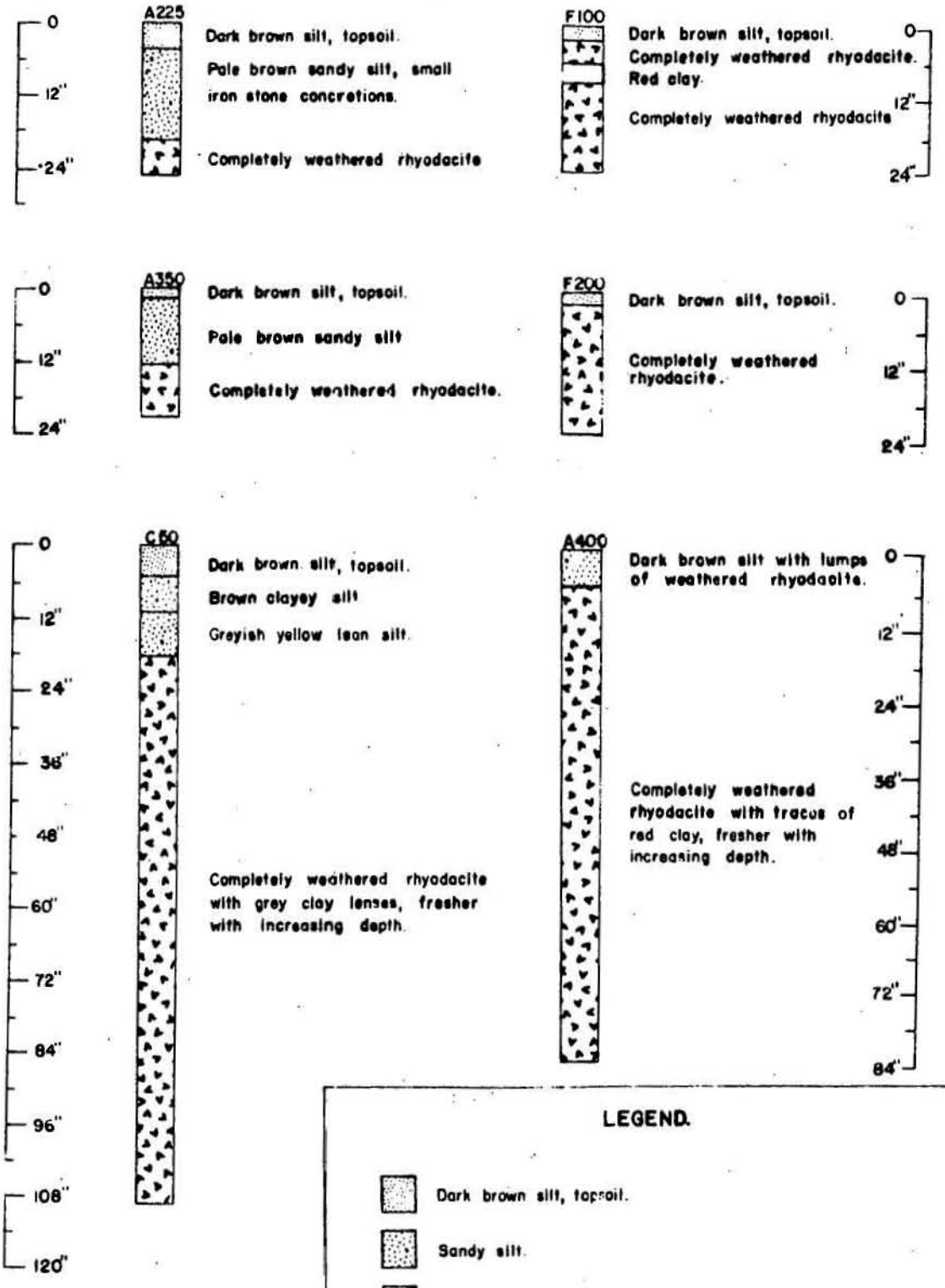
The reservoir sites are near the top of a catchment and about 300 feet higher than the surrounding plains. Recharge is good or excellent on the top of the hill, where soil cover is absent or skeletal. Discharge is generally thought to be good through fractured rock. The groundwater level is expected to be deeper than 30 feet below the surface.

Reservoir 6A (stage 1) is in a watercourse, in the centre of which black organic soil (more than 1 foot thick) occurs, indicating swampy conditions. In Augerhole A150, in this watercourse, water was struck at a depth of 4 feet. This is thought to be a localized perched aquifer in theoverburden. The discharge of thisaquifer appears to be restricted, but the restriction will be removed during excavation of the overburden.

Figure 2.

Belconnen Reservoirs 6A & 6B

Logs of Augerholes.



LEGEND.

- Dark brown silt, topsoil.
- Sandy silt.
- Red clay.
- Rhyodacite.

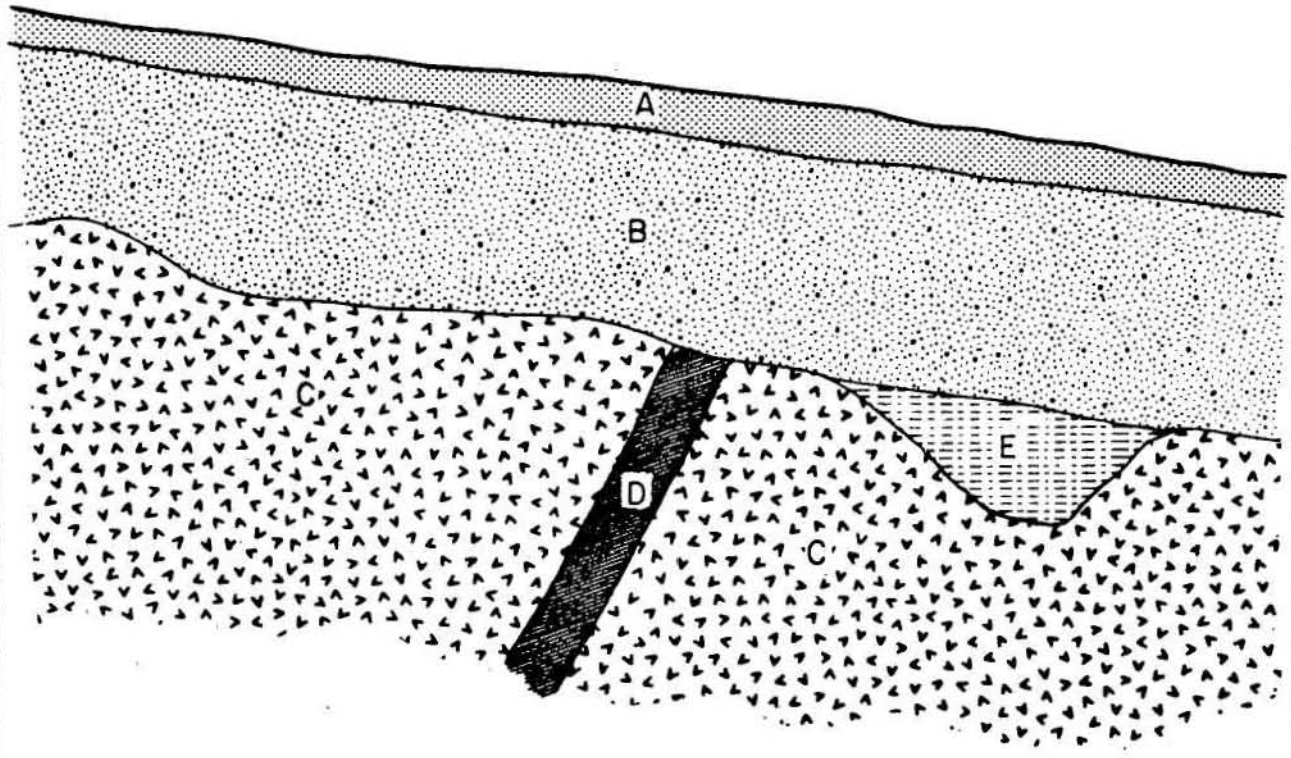
To accompany record 1972/59

Drawing No. 155/A16/865

FIGURE 3

Belconnen Reservoir Sites 6A and 6B

GENERALISED SOIL PROFILE



A: Topsoil, dark brown silt, 0-6" thick.

B: Indurated sandy silt, pale brown. 0-2' thick.

C: Completely weathered rhyodacite getting fresher with increasing depth.

D: Fracture zone in rhyodacite, filled with heavy red clay.

E: Relics of old soil. B horizon, consists of dark red, lean clay

Ground surface

A / B Soil boundary

To accompany Record 1972/59

155/A16/683

CONCLUSIONS

1. The augering carried out on the proposed reservoir sites confirmed the interpretation of the seismic work by Hill.

2. Slate inclusions may occur in the reservoir floors, especially in 6A (stage 1).

3. Deeply weathered fracture zones may also occur in the reservoir floors.

4. Attention should be given to the stability of the slope on the western side of 6A (stage 1).

5. Prior to construction of the foundations a site inspection should be made by a geologist in order to report on the soundness of the reservoir floors.

REFERENCES

HENDERSON, G.A.M., (in prep.) - Geological investigation, Belconnen sheets G3C, G3D, G4A, G4B, H3C and H4A, Australian Capital Territory 1966-1969. Bur. Miner. Resour. Aust. Rec. (unpubl.).

HILL, P.J., 1971 - Investigation of Belconnen No. 6A and 6B reservoir sites by seismic refraction method, A.C.T., 1971. Bur. Miner. Resour. Aust. Rec. 1971/90 (unpubl.).

TERZAGHI, K., and PECK, R.B., 1969 - Soil Mechanics in Engineering Practice. New York, John Wiley.

APPENDIX

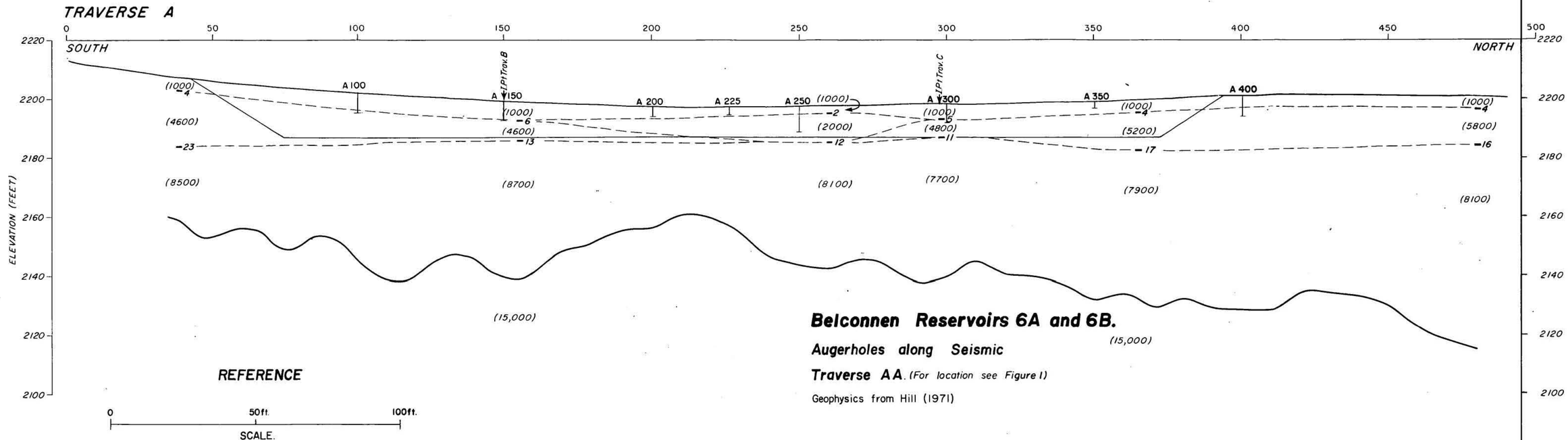
DEFINITIONS OF TERMS USED

Weathering of Rock

FRESH	:	No discolouration or loss in strength.
FRESH STAINED	:	Limonitic staining along fractures, rock otherwise fresh and shows no loss of strength.
SLIGHTLY WEATHERED	:	Rock is slightly discoloured, but not noticeably lower in strength than the fresh rock.
MODERATELY WEATHERED	:	Rock is discoloured and noticeably weakened; N- size drill core generally cannot be broken by hand across the rock fabric.
HIGHLY WEATHERED	:	Rock is discoloured and weakened; N- size drill core can generally be broken by hand across the rock fabric.
COMPLETELY WEATHERED	:	Rock is decomposed to soil, but the original rock fabric is mostly preserved.

Munsell soil colour chart was used for the description of soil and rock colours.

Plate I.



Belconnen Reservoirs 6A and 6B.

Augerholes along Seismic Traverse AA. *(For location see Figure 1)*

Geophysics from Hill (1971)

REFERENCE

0 50ft. 100ft.

SCALE.

A 200 — Augerhole with reference number.

(5200) Seismic velocity in formation (ft/sec)

– – – 17 – – Seismic velocity interfaces with depth indicated in feet.

Fresh bedrock boundary.

Cross-section of required excavation.

AMENDMENTS			
No.	Description	Author	Checked
A1			
A2			
A3			
A4			
A5			

SCALE 0 25 50 feet.

Base map/survey B.M.R. 155/B5–102.

Geology by J.A. Saltet.

Compiled and checked: J.A. Saltet. Project geologist

Checked and approved: Senior geologist

Supervising geologist

COMMONWEALTH OF AUSTRALIA
BUREAU OF MINERAL RESOURCES
CANBERRA, A.C.T.

TITLE: AUGERHOLES ALONG SEISMIC TRAVERSE AA.

PROJECT: BELCONNEN RESERVOIRS 6A & 6B

To accompany Record 1972/59

Drawn by A.S.G.

Drawing No. 155/A16/866