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UPPER COTTER DAM SITE INVESTIGATIONS

Dam Site C.

Progress Geological Report and Proposed Drilling Programme.

by

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INTRODUCTION.

Investigations have been extended to Dam Site C because detailed exploration of Dam Site A has indicated that the eastern abutment does not provide adequate strength for construction of an arch dam.

Dam Site C is situated in quartzite in a valley gorge which promises suitable abutments for an arch dam and, although the site is some 4 miles further up-stream from A, an arch dam at Site C, to impound the required storage, would cost less than a gravity dam to meet the same requirements at Site A.

A road-bench has been cut for about three miles up-stream from Site A along the western bank of the river, to the vicinity of Site C and is now trafficable to vehicles. Geological investigations were started at Site C on the 9th July but have not been continuous due to access difficulties and to the incidence of snow and rain. Although efficiency is decreased under these conditions the work was pushed ahead to provide some immediate information on the prospects of the site for the designing engineers and on the location of essential drilling targets.

The Site is covered by thick scrub which would have made plane table mapping too slow, but, as the Site has been surveyed, geological mapping is being done by plot-as-you-go compass and tape traverses controlled from the engineering survey pegs. Geological mapping to date has been shared by the writer, J. Foweraker and G. Burton.

It is emphasised that this is only a progress report on work which is far from complete. However, examination does indicate that the site well warrants a drilling programme to complete investigation.

GEOLOGY.

Site C lies in a valley gorge in the Tidbinbilla Quartzite which the writer considers is probably Silurian in age. Beds of the Quartzite have been hardened by thermal metamorphism of the intrusive Silurian granite which crops out some 600 feet north of the proposed wall on the western abutment; some quarter of a mile east of the eastern abutment, and may well underlie Quartzite in the river at the proposed dam. The granite is, in most places, a medium to coarse grained biotite granite; it has not been studied in detail as yet because, on present information, it does not appear in the foundations of the dam.

The western limit of the Tidbinbilla Quartzite, and of the granite, is the Cotter Fault which runs in meridional direction some 1200 feet west of Site C (see Plate 1). The fault probably dips at a high angle to the west and is regarded as a high-angle reverse.

The amount of rock outcrop in the area is less than was expected and, in outcrop mapping areas of outcrop and areas covered by boulder scree or by soil and scree have been delineated.

Beds of the Tidbinbilla Quartzite at the dam site show a general meridional strike with dips ranging from 18-25° to the west. The stratigraphic succession from the fault saddle in the west to the eastern abutment has been worked out and, for ready reference, has been divided into informal "members", as shown on Plate 2. More detail will be available when costeans have been completed.

The main rock type is a fine to medium grained sandstone with varying degress of silicification. More correctly, these rocks include both quartz-sandstone and quartz-greywacke and consist of quartz grains with sericitic or chloritic matrix varying from about 5 to 15%. Member 2, near ~~at~~ the top of the sequence on the saddle, is a quartzite and shows slightly more silicification than observed in the middle members of the sequence. Members 5 and 6, in the river, areaalso quartzite and suggest that granite may underlie the rocks in the river bed. Finer grained sediments - interbeds of siltstone and claystone - occur in Member 3, and some have been observed in costean No. 1, near proposed top water level.

The marker bed, a prominent bed of hornfels (a metamorphosed and closely-jointed claystone or ashstone) is most useful in tracing structure and also indicates that clayey interbeds are likely to be hardened by contacted metamorphism and thus are less likely to provide the foundation problems commonly associated with claystone bands. The bands found in costean No. 1 appear, however, little hardened but these are in the zone of weathering and thin sections are being cut to investigate their mineral constitution.

The occurrence of calcareous beds within the sequence is under investigation; the presence of an actinolite-quartz rock in Member 3 - an alteration product of a calcareous or dolomitic quartz-greywacke - indicates that some calcareous beds occur. No additional examples have been found but since metamorphism would readily affect calcareous sediments it is likely that any original calcareous interbeds would be altered to fairly competent rocks.

Traces of bedding can be found in all members and range from indistinct bedding in otherwise massive rock to beds ranging from 2" to 6' or more. For instance, bedding in Member 5 ranges from 6" to 6' and averages about 12". Fine bedding is markedly developed only in Member 3 where finely bedded fine sands (found in scree) may well be interbedded with silts.

A finely bedded and partially brecciated sandstone occurs below the more massive beds of Member 7 on the eastern abutment; the character of this bed and the cause of brecciation is being investigated. This bed could prove a useful marker in the sub-surface section across the river.

The quartzite of Member 2, which crops out high on the western abutment is being investigated as a local source of aggregate. The nearest deposit of stream sand is at Top Flats, about 2 miles downstream from Site C. Investigation of this source has yet to be completed.

STRUCTURE.

The overall structure at the site has been sought by mapping the hornfels marker bed (see Geological Map). The bed has been found on both sides of the site and inter-relates the sequences on both abutments. Strike and dip as determined from the trace of the marker bed and that determined from local bedding planes are in fairly close agreement and indicate a trend between 350° and 10° with westerly dip ranging from 18° to 25°, and averaging 20°.

The marker bed has been traced without displacement across the line of the proposed wall on both abutments and its position in the section across the river (see Geological Section) leaves no room for a major displacement between the two abutments.

However, mapping so far as revealed three breaks in this otherwise uniformly west-dipping structure. Two of these lie up-stream and one down-stream from the proposed wall. These breaks are as follows:-

(1) A fault or shear zone with a throw of about 12-15 ft. displaces the marker bed about 80' up-stream from the wall on the western abutment (see Geological Map). The fault zone is largely obscured by scree, but some silicification is apparent. The strike is probably south-east and the dip close to vertical with down-throw to the west.

Reconnaissance suggests that this fault zone can be traced up the eastern abutment some 200' up-stream from the wall. The fault is not sufficiently close to the proposed wall to present any engineering difficulties.

(2) Mapping on the western abutment, east of Bench Mark 89 and well down-stream from the wall, has failed to pick up the marker bed in its calculated position. Fault displacement is suspected and this area will be investigated in detail. Faulting here is well removed from the proposed wall but may cut the proposed diversion tunnel.

(3) The third break in structure occurs at the sharp bend in the river some 300' up-stream from the proposed wall. Definite displacement of the marker bed appeared to indicate the existence of a fault with a throw of about 30' striking a little east of north and trending along the river. A fault in this position would traverse the wall and could promote leakage, if not weakness in foundation. The delineation of this possible fault was important, and considerable time had to be devoted to the detailed search of the scrub and scree-covered area up-stream from the wall. Mapping has revealed no evidence whatsoever of faults trending with the river; in fact, the structural anomaly at the river bend still defies explanation by sub-surface faulting. A feasible explanation, now being investigated, is that the displacement is the result of a land slip. In this case, the anomaly has no direct bearing on the proposed site of the wall. The possibility of faults trending with the river will, in any case, be checked by drilling.

The competent sandstones forming the dam site are well jointed and detailed study of joint frequency and direction, as well as the water pressure testing of drill holes, will be carried out in the investigation of problems of leakage. The strike and dip of major joints, but not their frequency, are shown on the accompanying geological plan.

ENGINEERING GEOLOGY.

Evidence from detailed geological mapping, and that from three costeans, indicates that Site C well warrants a drilling programme to complete the investigation.

The greater part of both abutments lies in bedded sandstone and quartzite with increased silicification in the lower beds on both sides of the gorge.

There are few interbeds of siltstone or claystone and these are likely to be fairly competent below the zone of weathering due to alteration from the neighbouring granite mass.

Detailed mapping of the fault at Dam Site C has been completed in the vicinity of the western abutment. The length of fault zone across the fault saddle, above the top water level of the proposed dam, is approximately 1,000 ft., which is more than was anticipated, and evidence of a water table north of the saddle, approximately at top water level, indicates

that the chances of leakage through the fault zone are insignificant.

However, there are a number of points which need careful investigation by drilling and by surface work.

(1) On the eastern abutment, near river level, Member 7 is underlain by a thinly bedded sandstone which has weathered deeply at the base of the cliff on the down-stream side of the eastern abutment. The character and thickness of these beds and their exact position underneath the proposed wall will be sought so that the possibility of slip, induced along the westerly dipping bedding planes, can be assessed.

(2) The eastern abutment looks solid but the extent to which joint blocks have 'crept' on the gently dipping bedding planes needs further investigation.

(3) Present evidence does not favour faulting along the river between the abutments but drill holes will check this. Any displacement will be obvious if the thinly bedded sandstone below the base of Member 7 can be recognised in drill holes.

(4) The study of jointing in relation to foundations and possible leakage has already been mentioned.

(5) A zone of silicification, shown up in costean No. 2, on the western abutment needs further delineation.

(6) The western abutment near top water level needs investigation by drilling to establish the character of the claystone interbeds at the bottom of Member 3 in which the top of the wall will be emplaced.

PROSPOED DIAMOND DRILL PROGRAMME.

A tenative diamond drilling programme has been worked out and the approximate location of holes is shown on the accompanying plan and section. This programme is a minimum one and is likely to be changed as sub-surface data become available. The holes have been numbered in order of importance according to present geological information. The total footage of the tentative drilling programme is approximately 750 feet.

The programme should have started on the eastern abutment but, as access will not be secured for a week or so, a start will have to be made on D.D.3 which has been designed to explore under the river and beneath the wall from the western side. The sequence of further drilling will, to some extent, depend on the results of D.D.3 but, if access to the eastern bank is not available when D.D.3 is completed, D.D.4, a vertical hole within the proposed wall near water level, will have to be drilled.

The drill should then be shifted to the eastern abutment and, unless the programme is changed, holes drilled in the order - 1, 2, 3.

It may be desirable to drill a second angle-hole under the river from the eastern abutment; this does not appear essential at present and a decision may well await sub-surface data from early drill holes.

The proving of the upper part of the western abutment and exploration of the ridge above top water level and to the level of the proposed diversion tunnel may be left to the end of the programme.

PROGRESS GEOLOGICAL PLAN

DAM SITE "C"

UPPER COTTER RIVER

Scale:- 50 Feet to 1 Inch.

0 50 100 150 200

Bureau of Mineral Resources. Canberra.
July 1956.

Legend

- Cow Flat Granite
- Tidbinbilla-Quartzite (outcrops), qtz-sandstone, qtz-greywacke and quartzite.
- Sheared siltstone and qtz greywacke (Phyllite)
- Hornfels Marker Bed
- D.O. Disturbed Outcrops
- B.S. Boulder Scree
- S.S. Soil and Scree.

Plate 1

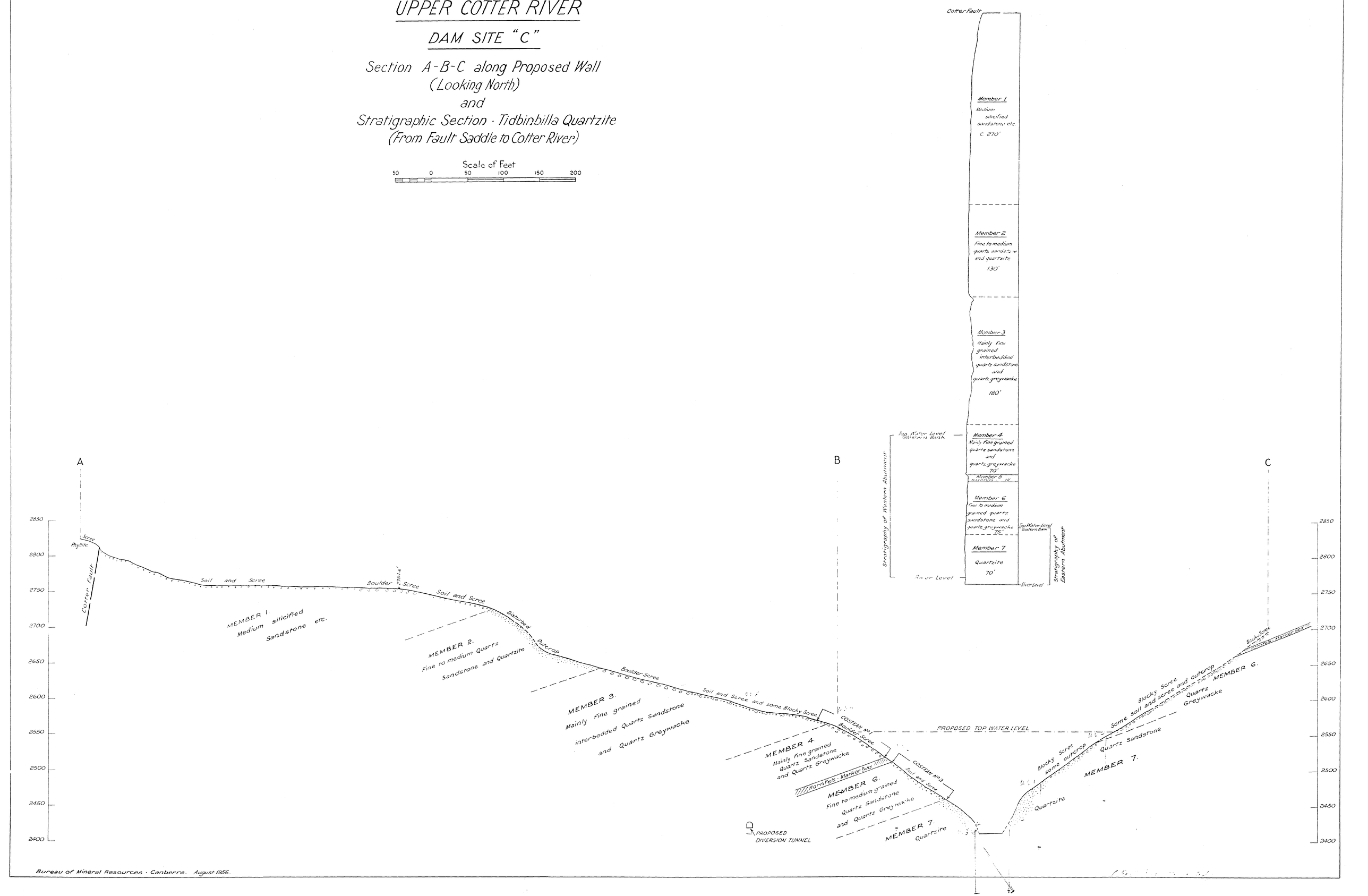
Plate 2.

UPPER COTTER RIVER

DAM SITE "C"

Section A-B-C along Proposed Wall
(Looking North)
and
Stratigraphic Section - Tidbinbilla Quartzite
(From Fault Saddle to Cotter River)

Scale of Feet
50 0 50 100 150 200



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