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DEPARTMENT OF NATIONAL DEVELOPMENT.

BUREAU OF MINERAL RESOURCES

GEOLOGY AND GEOPHYSICS.

RECORDS.

1957/17

SECOND PROGRESS REPORT

DAM SITE "C"

UPPER COTTER RIVER, A.C.T.

by

L.C. Noakes, J.C. Foweraker and G.M. Burton.

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INTRODUCTION

Core drilling, water pressure testing and further detailed geological mapping have been carried out at dam site "C" since September, 1956, when the First Progress Report containing the diamond drilling programme was issued.

Although the exploration programme is not yet complete, geological conditions are sufficiently clear to justify recommendation of the site for the construction of an arch dam. The purpose of the Report is to record progress and to confirm this recommendation.

Much of the information is presented in the maps and sections accompanying the Report. The general geology of the site has already been described in the First Progress Report (Record 1956/98, to which readers are referred); this general picture has been confirmed and additional information is provided in this Report.

EXPLORATION

Drilling

The drilling of 8 holes, totalling 900 feet, has been completed on the site of the proposed wall. This footage includes the seven holes originally proposed (780 feet), with an additional hole (No. 8 - 120 feet) to test fractures found in drill holes in the western abutment.

The drill used throughout was a Mindrill E1000, with hydraulic head, powered by an air cooled "Wisconsin" engine; this is owned by the Works Department, and was operated, except for the last hole (No. 5), by drillers on loan from the Snowy Mountains Hydro-Electric Authority.

An NM core barrel (with free inner tube), providing a core of 2.1/16 inch diameter, was used as standard equipment, except for small sections in holes Nos. 4 and 5 where an NX barrel was used as a substitute. Core recovery with the NM barrel was 98-100 per cent and was superior to that provided by the orthodox NX equipment. Drilling difficulties were found only in holes 6, 7 and 8, high on the western bank, where finely jointed rock caused some caving and blockage.

Holes were drilled in the order 3, 1, 2, 4, 6, 7, 8, 5 - approximately the order of importance. Geological logs of all holes accompany this report and the main geological features are shown in Plates 4 and 5.

Water Pressure Testing

All drill holes were tested for leakage except No. 8, in which caving threatened to jam or damage the packers. Both mechanical packers on loan from the Snowy Mountains Hydro-Electric Authority and balloon packers designed by the Works Department were used; both types gave similar results in firm ground, but the balloon packers provided much more reliable sealing in fractured ground. Most of the testing was done by single packer in approximately 20 feet sections as the drilling of the hole progressed.

The results of water pressure testing are shown diagramatically in Plate 4 and their significance is discussed in a later section. One uniform pressure could not be used throughout the water pressure testing because high pressure is avoided in the upper sections of drill holes due to the danger of opening up fractures, and a low pressure was not possible in the lower sections of "dry" holes due to the head of water in the pipes connected to the packer.

Costeaning

Costeans have been dug down the slope in the vicinity of the axis of the wall on both sides of the valley and, high on the eastern abutment, an excavation has been made to check the depth of the mantle of soil, scree and weathered rock. The position of these excavations is shown on Plate 1 and detailed geological plans and sections will be provided in the final Report.

GEOLOGY AND STRUCTURE

Lithology

The lithological sequence within the Tidbinbilla Quartzite in which the dam site is situated has already been given in a previous Report; a stratigraphic section is reproduced in Plate 2. The sequence exposed in the vicinity of the dam site shows a progressive change in sedimentation - the base of the section is quartz sandstone* and quartzite; interbeds of siltstone and claystone** become progressively prominent in the higher beds. The dam site lies, suitably, in the lower members of the succession where fine sedimentation is restricted to -

(1) thin beds or lenses of sedimentary breccia where thin claystone bands have been removed by current erosion and fragments deposited in the succeeding sandy bed;

(2) some thin claystone bands or lenses in member 6 on the western abutment;

(3) the marker bed (6-7 feet) probably an ashstone which is a finely grained, hard rock.

With one exception the sedimentary breccias found are less than 6 inches in thickness and are discontinuous; they could result in weak pockets but will not constitute continuous weak bands in the sandstone. The exception is the sedimentary breccia bed in member 7, which is a lenticular bed, up to 6 feet in thickness under the eastern abutment, consisting of fine or fine-medium grained, finely bedded quartz sandstone with bands or lenses of sedimentary breccia containing angular fragments of claystone. This bed lenses out under the river along the axis of the dam, but occurs with reduced thickness of about 12 inches in the western bank downstream from the dam site. The bed is weathered both in outcrop and in drill cores and gives fragmented core due to many fractures and the friable character of some of the sandstone.

* then quartz sandstones in places grade into quartz greywacke but for simplicity in this Report they are referred to as quartz sandstones.

** massive sedimentary rock composed of grains of clay fraction size (less than .004mm) - not to be confused with clay which is unconsolidated material.

The claystone bands or lenses in member 6 occur in the top 20-30 feet, below the marker bed; they include sedimentary breccias, claystone lenses and thin continuous claystone bands. No more than 2 inches of claystone or siltstone appears in the core and no core was lost. The occurrence of such thin lenses dipping into the abutment has little engineering significance, but both members 4 and 6 in the western abutment, though largely composed of quartz sandstone, are less competent* than member 7 and produce much more fragmented core. This is probably consequent on thinner bedding (averaging 1-2 foot beds in general), the greater variation in grain size between beds and closer jointing. Proximity to the Cotter Fault may also be a factor leading to fragmented core.

The marker bed is consistently hard and competent, both in outcrop and in core; it is closely jointed but provides strong foundations. The average thickness is 6-7 feet although where intersected by D.D.8 the marker consists of about 3 feet of ashstone grading downwards into 3 feet of fine grained blue quartzite.

The sandstones high on both abutments show medium to slight weathering to a depth of some 20 feet from the surface, but elsewhere surface weathering is much shallower and in general the surface weathering of the rocks themselves will not provide foundation problems. On the other hand, closely spaced and comparatively open joints have allowed oxygenated water to penetrate and circulate well below the present water table, with the result that iron staining and a degree of weathering is found in joints throughout the length of all drill holes. Consequent on this circulation, minor beds in the sequence which are more susecptible to weathering than the general run of sandstone, have been weathered; the sedimentary breccia bed in the eastern abutment is an example of this. The distribution of such weathered bands, main zones of fragmented core and the occurrence of sedimentary breccia are shown on Plate 4.

Structure

Folding. The beds at the dam site dip generally to the west-south-west at angles ranging from 12° to 27°. However, the rocks have suffered more deformation than these comparatively gentle dips would suggest. Small rolls apparently accompanied the folding or tilting of the beds, and evidence of small shearing movements along many joint and bedding planes suggests that the rocks have suffered structural deformation on more than one occasion.

In more detail, the structure of the sediments at the site is shown by the structure contours on the marker and sedimentary breccia beds (Plate 3). There is a swing in the strike of the beds from about 340° ** on the upstream side of the wall to about 350° on the downstream side. The structure contours show only an average strike; variations of up to 20° from this general strike have been noted in individual outcrops and these are apparently due to small rolls in the bedding. The dip flattens from about 20° on the eastern abutment to 12° high on the western abutment and, as in the case of the strike, variations occur in outcrop.

* competent - combining sufficient firmness and flexibility to transmit pressure and, by flexure under thrust, to lift a superincumbent load.

** All directions quoted in the Report are magnetic.

The structure contours on the two beds confirm that the sedimentary breccia behaves as a conformable bed within the sequence; the 3 foot variation in the stratigraphic interval, as shown on Plate 3, is not significant since the breccia bed is lensing out on the western bank. The roll on the marker bed on the downstream side of the wall is under investigation; it may be exaggerated by present data because more exposure is needed to prove that all points surveyed in this vicinity are, in fact, on the upper surface of the marker. However, there is some evidence of a roll and it is possible that the structure is a flexure increasing in severity up the sequence west of the river and this may pass into a fold displacement. Any possible displacement of the marker would be very small and the structure is not sufficiently close to the proposed wall to affect stability or promote leakage.

Faulting. Three structural breaks indicated by the mapping of the marker bed on both sides of the river were mentioned in the previous report and no additional faults have been found. The possible faulting some 400 feet downstream from the site cannot affect the wall itself and has yet to be investigated. The near vertical transcurrent fault which displaces the marker some 12 feet horizontally about 80 feet on the upstream side of the wall on the western abutment does not closely approach the wall nor underlie it. The displacement of the marker bed and abnormally high dips in the vicinity of the river bend upstream from the site are interpreted as disruption due to a land slip, whose approximate boundaries are shown on Plate 1. Interpretation of this break as a fault would indicate a fracture running down river normally to the wall but lack of evidence of faulting in D.D.3 and the occurrence of the sedimentary breccia bed on both sides of the river prove that no such fracture exists.

There is no evidence, therefore, of any sifnificant faults in or very close to the proposed wall, either in outcrop or in drill holes; with almost 100 per cent core recovery we are confident that significant faults would not have been missed.

Jointing. The structures at the site with the most engineering significance are the joints which have largely controlled erosion. The pattern of jointing is shown in histograms on Plate 6. Measurements of joints in the eastern abutment showed little variation and strikes are represented by only one histogram, whereas variations on the western abutment required two histograms.

Variation of pattern along the wall is slight but definite and may be due to a number of factors, particularly original difference in competence and severity of later movements. In general, the pattern includes two sets of major, steeply dipping joints, one trending about north-east and the other about north-west, with the angle between them slightly acute to the west. On the western abutment a minor set of steeply dipping joints trends approximately east. The major set trending north-east dip south-east rather than north-west, but the set trending north-west apparently dip equally north-east or south-west. The minor set trending east probably favours a northerly dip. Recorded dips range from 15° to vertical but most are very steep. There are probably more flat dips than have been recorded; in poorly bedded sandstone it is difficult, both in outcrop and in drill core, to distinguish between bedding and jointing along sub-parallel planes. However, where bedding planes are clear, flatly dipping joints are not prominent.

This joint pattern is in keeping with compression in an east-west direction - two sets of shear joints oblique to the direction of the principal force with a minor set of tension joints parallel to it. The observed scatter in the measurements is not surprising since such rocks have been subjected to at least two periods of deformation, which apparently followed the general pattern; later stresses were accommodated by movements and adjustment along the previously formed joints. The small transcurrent fault upstream from the wall follows one of the major joint directions. Some of the major joints of both sets, particularly on the western abutment and beneath the river, show a film of clay gouge suggestive of slight movement and in some places a displacement of up to 3 inches, mainly in a horizontal direction, has been noted.

Some bedding planes also show films of gouge and the essential pattern of deformation at the site is accommodation to stress by minute differential movements of blocks bounded by joint and bedding planes, with little demonstrable fault displacement. Folding toward the end of Silurian time, followed slightly later by main movement on the Cotter Fault and emplacement of granite, and additional stresses in the Devonian period, doubtless all contributed to the deformation of the Tidbinbilla Quartzite.

ENGINEERING GEOLOGY

Detailed investigations have confirmed the earlier promise that the Tidbinbilla Quartzite would provide sufficiently strong abutments for an arch dam at dam site "C" and that the main engineering problem would be the grouting of joints.

Foundations

The eastern abutment consists of quartzite and quartz sandstone with a few thin weathered zones, and a sedimentary breccia bed, dipping at about 20° toward the river (see Plate 4). The western abutment consists mainly of quartzite and quartz sandstone but includes some interbeds or lenses of siltstone and claystone. The beds are thinner or less massive than those in the eastern abutment, jointing is more pronounced and in general the rocks of the western abutment are not as strong as those on the eastern bank of the river.

On the other hand, the western abutment has the advantage of more suitable structure in that the beds dip upstream and not toward the river, so that the chances of differential movement on clayey bands or lenses are minimised.

Early investigation indicated that foundation weaknesses could lie in four main directions -

(1) Possible landslip or creep in blocks which appeared to be solid outcrop in the eastern abutment. The recognition of a landslip farther upstream underlined the possibility of slip on the eastern abutment where beds dip with the valley slope.

(2) The possibility of the sedimentary breccia bed providing a plane of slip or weakness in the eastern abutment.

(3) The presence of the cliff in the eastern abutment some 80 feet downstream from the proposed wall.

(4) The character of the western abutment near proposed topwater level of the dam, where cores were considerably fragmented and included some claystone bands.

These points are discussed in order.

(1) Apart from a small surface slip between the excavation and the site of D.D.2 and 4, no evidence of major slip has been found on the eastern abutment; the evidence pointing to outcrop in situ is convincing.

The problem was tackled from a number of angles. Core drilling and water pressure testing would be expected to provide evidence of major slip and holes were sited partly with this in view. The core (with almost 100 per cent recovery) shows no slip gouge or planes of movement which could reasonably be interpreted as due to major slip. Water pressure testing shows a fairly regular decline in leakage with depth in all holes and no restricted zones of high leakage. High leakage at the top of holes 2 and 4 could include a restricted zone of high leakage, but the leakage in this section is of the same order as that determined at the top of hole 7, which is in a similar position in regard to the zone of weathering on the other bank. Furthermore, exposures in the excavation downslope from holes 2 and 4 show, beneath a surface slip, bedded and jointed sandstone with no evidence of disturbance.

The measurement of 180 joints in groups up the eastern abutment shows no noticeable variation, and finally, there is no evidence of slip in the cliff section downstream from the proposed wall. We are, therefore, satisfied that foundations on the eastern abutment will be in rock in situ.

(2) The sedimentary breccia bed consists largely of thin bedded sandstone in which claystone fragments occur in random layers. The proportion of claystone material is, therefore, very small. Fragmentation of the core is due to the presence of many small fractures and the friable character of some of the sandstone. The relative weakness of the breccia bed is shown in the cliff downstream from the proposed wall where erosion of the bed has caused undercutting of the quartzite, but susceptibility to surface erosion does not necessarily infer weakness under load. Beneath the proposed wall the bed lies below the water table, is very tight under water pressure and has already stood up to far greater loads than those likely to be imposed by an arch dam. The bed would underlie the foundations of the dam on the eastern bank of the river by about 20 feet; it pinches out under the river between holes 5 and 3.

(3) The problem as to what thickness of rock is required between the arch on the eastern abutment and the cliff on the downstream side to take the downstream component of the thrust is not within our competence; we may point out that since the joints on and near the cliff are open, the effective thickness of strong rock between wall centre-line and cliff to resist shear is less than the actual thickness, which ranges from 80-100 feet (see Plate 1). The effective thickness is likely to be about 60-80 feet.

(4) Cores from holes 6 and 7 showed considerable fragmentation, some claystone bands and a little brecciation; hole 8 was sited to explore the abutment between 6 and 7 and to probe for a possible fault or shear. The beds fragmented in core in holes 6 and 7 stand well in costean exposure on the western abutment.

Hole 8 disclosed no shear or fault and the third sub-surface intersection of the marker bed allowed structure contours to be plotted on the top of the marker; these showed no displacement.

The explanation of fragmented core in these holes has already been mentioned; it is consequent on close jointing in thinly-bedded sandstone which includes some claystone bands or lenses and to the friable character of some of the sandstone. The variation in joint pattern in this area is itself strongly suggestive of difference in competence between these rocks and those farther east along the wall. Slight differential movement along the joint planes, some of which show a spacing as close as $\frac{1}{4}$ inch in core, would impart a tendency to fragmentation, particularly in a core where support is removed from all sides. This seems a logical explanation of the difference in behaviour between unsupported core and costean where support is withdrawn from one side only.

It follows that the costean is a more reliable guide than the core to the likely character of these rocks in foundation excavations. In general they should stand well, although blasting will need careful control and close grouting will be necessary. The worst section is likely to be over the outcrop of member 6, between the marker bed and the top of the cliff below. Claystone bands and weathered zones will need special scrutiny in excavation, but these will dip upstream and into the ridge.

The main thrust of the arch will be suitably directed approximately along the strike of the beds.

Our conclusion is that the abutments at site "C" are sound, although careful grouting and excavation will be needed, particularly on the western abutment. The probable depth of excavation needs more investigation but it is likely to be of the order of a few feet only near the river, rising to some 15-18 feet high on the eastern side and over much of the western abutment.

Leakage

Thorough grouting to control leakage is the obvious problem where the site lies largely in competent quartzites with a well developed joint system and with a consequent low water table. The results of water pressure testing, shown on Plate 4, give a fairly clear picture of leakage conditions at the site. These results show convincingly that leakage rates cannot be correlated with individual beds or members, but are controlled by fractures, mainly in the zone of weathering above the water table.

Leakage rates decline fairly regularly with depth and except for holes 3 and 7 are low below water level. Significant leakage occurs under the river to a depth of 60 feet, suggesting open joints which have partly controlled the position of the river. Rates of up to 6 gallons per minute, at a pressure of 50 lbs. per square inch, are shown in jointed sandstone below water level in hole 7.

The highest leakage rates, 12-14 gallons per minute at 15 p.s.i. occur high on both abutments where the period of weathering has been the longest and where circulation is least impeded. These sections will have little head of water when the dam is full, but sections of the abutments which will be under pressure of the order of 30 lbs. p.s.i. when the dam is full also show a comparatively high leakage rate of 6-8 gallons per minute under approximately that pressure.

The joints mainly responsible for leakage are the shear joints, one set of which is orientated normal to the wall along its entire length. The tension joints are comparatively few; some are curved and they are not as persistent as the planar shear joints.

To prevent serious leakage an effective grout curtain will have to extend to the level of the present water table and for 60 feet below the river. Information from which may be determined the necessary extension of this curtain east and west of the wall is being sought in holes 9 and 10, whose positions are shown on Plate 1.

Seismicity

Evidence on the likely incidence of earthquakes in the Cotter River area was discussed in 1946 (B.M.R. Record 1946/12) and the question has been recently reviewed; only our conclusions are given here.

We consider that available geological and seismological evidence does not support the view that the design of a dam in the area should include a safety factor to cope with earthquakes with an acceleration of .1g. This is the standard factor for construction in major earthquake zones and in our opinion, is not really necessary in this area. We suggest that a factor based on an acceleration of .05g would be more in keeping with the geological facts.

Diversion Tunnel

The eastern bank of the river offers the more suitable site for the diversion tunnel; a tunnel sited in the western bank would be longer and would probably need more support. A tunnel laid out to follow the sedimentary breccia bed, for ease in driving, was too close to the foundation of the wall and needs to be farther west in the abutment. The tunnel should be sited to lie at least 10 feet below the breccia bed, for as greater distance as possible, to possibly avoid overbreak up into the bed or into the quartzite immediately below the bed which normally produces broken core.

Rock Materials

These will be the subject of a separate report when investigations are more complete. Aggregate and sand could be transported from Canberra and the Murrumbidgee River respectively, but the investigation of possible sources nearer the dam site is proceeding as fast as the available supply of labour permits.

The quartzite bed high on the western bank of the river near the dam site and close to the Cotter Fault promises some 60,000 to 70,000 cubic yards of aggregate under overburden ranging from 0 to 20 feet; drilling will be necessary to prove quantity and quality. Possible sources of quartzite aggregate on the eastern bank of the river are also being investigated.

Supplies of gravel, only part of which would need to be crushed, are being investigated at Top Flats and Cow Flat, which lie within a few miles of dam site "C"; there is little doubt that sufficient quantity will be found but the deposits are thin and a large area would need to be worked. The only significant quantity of sand in the locality accompanies the gravels at Top Flats; there is some doubt at this stage whether a sufficient quantity would be available. Testing of alternative sources of aggregate and sand will be arranged when exploration has been sufficiently advanced to provide reliable representative samples.

FURTHER WORK

Holes 9 and 10 will be completed to provide data on the position of the water table and on leakage rates in the rocks immediately east and west of the proposed wall; a short exploratory drillhole may be necessary to provide information on conditions near the southern end of the diversion tunnel.

Geological work will be completed on and near the site, investigation of sources of rock material concluded and the final report compiled. This will include a special report for use by contractors.

SNOWY MOUNTAINS HYDRO-ELECTRIC AUTHORITY

GEOLOGICAL LOG OF DRILL HOLE

PROJECT Upper Cotter Dam Site "C" FEATURE

HOLE No. D.D. 1 CO-ORDINATES: E M N M R.L. GROUND 2484.3 ft.

LOCATION East Bank, on site of proposed wall ANGLE FROM HORIZONTAL 70° DIRECTION 94° M

ROCK TYPE & DEGREE OF WEATHERING SHOWN IN CORE	DESCRIPTION	SIZE OF ~~R.L.~~ CORE	DEPTH ~~& SIZE OF CORE~~	LOG	LIFT & CORE RECOVERY (%)	STRUCTURES JOINTS, VEINS, SEAMS FAULTS, CRUSHED ZONES	NOTES WATER LEVEL (DATE) DRILLING WATER RETURN CHARACTER OF DRILL CUTTINGS	PERCOLATION TEST DEPTH (FT) FROM	TO	LOSS IN G.P.M.	PRESSURE P.S.I.	LENGTH OF TEST (MIN)
Fine grained quartzite and quartz sandstone mainly fresh					50, 100, 100, 100, 76	Joints, with limonite staining at 30° and at 90° to length of core. Core broken and partly lost 6'-7'4" in fine to medium grained, qtz sandstone, weathered and stained. Pieces upto 1'						
Intraformational Sharpstone Layer	Fine grained qtz sandstone and chloritic mudstone, with pyrites	N.M.	9'6"		100							
(Sedimentary Breccia)	weathered, broken, partly lost	N.M.	11'0"		44	Pieces minute to 3"						
Fine grained quartzite, fresh					100, 100	Joints with limonite staining at 20° to length of core. Pieces vary, 1" to 6"						
Quartzite and mudstone fragments and pockets weathered.	quartzite, quartz sandstone quartz fragments, pockets and veins of chloritic mudstone at 30° to length of core.	N.M.	15'6"		100							
		N.M.	17'0"			limonite staining in joints.						
Fine grained quartzite fresh		N.M.	18'6"			limonite staining in joints pieces 1"-6"						
Quartzite with pockets and veins of mudstone and qtz	Pockets and veins of soft chloritic mudstone, running 30° to length of core		19'0"		100, 100							
Fine grained quartzite fresh.		N.M.	28'9"		100, 100, 100	Joints with limonite staining Jointing mostly at 80° and 10° to length of core. Pieces 1" to 18", average 5" 6" weathered band at 20'9"						
Fine grained quartzite		N.M.	30'0"			Core and joints with limonite staining. Broken and slightly weathered 29'8"-30'						
Fine grained quartzite fresh	Some pyrites at 43' 6" - 44'	N.M.	43'9"		100, 100, 100, 100, 100, 100	5" quartz vein parallel with core. Joints with limonite staining. Jointing at 20° and 80° to length of core. Broken zone 37'9" - 38' Pieces ½" to 21" average 7"						
Quartzite and quartz sandstone	Some brown weathered particles present Pyrites 43'6"-44'	NM	56'		100	Joints with limonite staining. Jointing at 20° and 90° with length of core Pieces 1" to 2'4" average 9"						
Intraformational Sharpstone Layer Weathered	Stained quartz sandstone some quartzite, with lenses of mudstone	N.M.	57'2"			core jointed and broken especially at 56'						
Quartzite and quartz sandstone	Quartzite and qtz sandstone, stained and broken, some fine weathered particles	N.M.	58'9"		100	Core stained jointed and broken						
Sedimentary Breccia	Quartzite, qtz. sandstone, mudstone		59'3"			Core stained. Pieces 1" to 2"						
Quartzite and fine-medium grained quartz sandstone	Core stained, weathered particles present	N.M.	65'0"		100, 100	Limonite staining in core and in joints. Core very broken and jointed and in small pieces Pieces minute to 3"						
Fine grained quartz sandstone and quartzite fresh	Some areas of core show increased silicification	N.M.	88'0"		100, 100, 100, 100, 100	Limonite staining in joints and in parts of core adjacent to joints Jointing at 75° and parallel to length of core Pieces ½" to 2'2" average 5" Thin lenses of mudstone present at 81'2" Small broken zone at 86'						
Quartzite stained	Fine qtz grains weathered brown particles	N.M.	89'6"		100	Fragmented due to jointing limonite staining. pieces ½" to 2"						
Quartzite stained	Fine quartz grains weathered brown particles	N.M.	91'1"		100	Jointing with limonite parallel to core. Fine grained seam at 89'7"						

DRILL No.

TYPE Mindrill

DRILLER B. Grech

COMMENCED 21/11/56

COMPLETED 30/11/56

ENGINEERING GEOLOGY SECTION

LOGGED John C. Fowerchec

SHEET No.

DRAWN

CHECKED

SUBMITTED

VERT. SCALE

SHEET ... OF ...

DRAWING No.

P

SNOWY MOUNTAINS HYDRO-ELECTRIC AUTHORITY

GEOLOGICAL LOG OF DRILL HOLE

PROJECT *Upper Cotter Dam Site "C"* FEATURE

HOLE No. *D.D. 2* CO-ORDINATES: E. M. , N. M. R.L. GROUND

LOCATION *East Bank, near top water level, on site of proposed wall* ANGLE FROM HORIZONTAL *70°* DIRECTION *42½° M.*

ROCK TYPE & DEGREE OF WEATHERING SHOWN IN CORE	DESCRIPTION	SIZE ~~R.L.~~ OF CORE	DEPTH & ~~SIZE OF CORE~~	LOG	LIFT & CORE RECOVERY (%)	STRUCTURES JOINTS, VEINS, SEAMS FAULTS, CRUSHED ZONES	NOTES WATER LEVEL (DATE) DRILLING WATER RETURN CHARACTER OF DRILL CUTTINGS	PERCOLATION TEST DEPTH (FT) FROM	TO	LOSS IN G.P.M.	PRESSURE (P.S.I.)	LENGTH OF TEST (min)
Highly silicified quartz sandstone and quartzite	Hard core, with dark streaks running at 35° to 45° with the core length from 0'-10'. ¼" thick dark brown bed running across core at 60° to length of core at 13½'	Casing	4'3"		50, 100, 100	Joints with faint limonite staining. Jointing often running parallel with dark lines, & at 35° to 45° to length of core. 13½-15' joints with white clay coating. Many joints at 80° to length of core. Pieces 1" to 12" average 3" to 4"						
		N.X	13'2"		77							
		N.M.	15'0"									
Quartz sandstone, weathered	Medium-hard core. Partly broken	N.M.	16'2"		100	Broken and jointed						
Silicified fine grained quartz sandstone to quartz greywacke becoming more silicified and passing into quartzite at 21 feet. Fresh.	Good hard core. Stained brown. Fine grained bed ¼" thick at 60° to length of core at 17'3" (Tree rootlets in this bed)				100, 100, 100	Joints with limonite and black oxide staining. Jointing at 25°, 65° and parallel with length of core. Pieces 1" to 8" average 3" to 5"						
		N.M	28'0"		100							
Medium grained highly silicified grey quartz sandstone	Good fresh hard core	N.M.	29'3"		100	Faint limonite staining in joints. 40°-50° and parallel with core length. Pieces 3"-6"						
Brown med. gr. quartz sandstone becoming more silicified towards the base of section.	Soft to medium hard, fractured and broken and stained 29'3"-30'. Good core 30'-33'	N.M.	33'0"		100, 100, 100, 100	Joints at 65° to length of core with limonite staining						
Grey Quartzite and highly silicified quartz sandstone.	Good core, but well jointed. Broken zones described below. Core often showing a brown and grey mottling or streak. 37'6" - 38' Badly fractured broken and stained zone. 40'8" to 41' Broken and crumbled core due to softer brown quartz sandstone and mudstone beds breaking up. 52'6" - 53' area, with increased quartz content, broken and fractured. 56'3" - 58'3" close jointed and broken core. 72'-73' Broken core due to vertical jointing. 59'6" - 69'6" grey streaks at 35° to length of core and appear similar to bedding				100, 100, 100, 100, 100, 100	28'-37' Core well jointed with limonite and black oxide staining in joints. Joints here are at 10-20° with core length. Pieces minute to 1'. 38'-50' Good core with many joints at 60° to length of core. 41'-42'6" joints at 60° with half inch spacing. 50'-60' Many joints parallel to and at right angles to length of core. 60'-76'3" 40°-50° jointing and also parallel joints to length of core. 50' to 52'6" some thin quartz veins						
		N.M.	76'3"		100							
Highly silicified quartz sandstone with mudstone lenses	Mottling on core due to limonite staining. Many fractures.	N.M	79'2"			Many fractures running through core. Staining on core and in fractures. Pieces minute to 1.5"						
Sedimentary Breccia Bed. Quartzite and highly silicified quartz sandstone containing thin med-soft lenses and wedges of silicified mudstone	Core contains some mudstone lenses at 20°-30° with length of core. Some mudstone lenses are very soft and very weathered in appearance. Core generally badly broken and crumbled with many small fractures.	N.M.	86'2"		100, 100, 100, 100, 100							
Blue-grey quartzite partly stained with occasional thin lenses	Core contains some lenses of mudstone running at 60° to core length. Core broken. Pieces hard.	N.M.	89'1"		100, 100, 100	Many small fractures in core. Pieces minute to 5"						
Highly silicified quartz sandstone and quartzite - blue grey colour - Fresh.	Core has a streaky appearance. Good hard core with less jointing and larger pieces				100, 100, 100	Jointing with limonite staining. Less jointing than in above sections. Pieces 1"-14"						
		N.M	101'6"		100							

DRILL No.

TYPE *Mindrill*

DRILLER *A. Grech*

COMMENCED *7th Dec. 1956*

COMPLETED *19th Dec. 1956*

ENGINEERING GEOLOGY SECTION

LOGGED *John C. Fawcraker*

SHEET No.

DRAWN

CHECKED

SUBMITTED

VERT. SCALE

SHEET ...... OF ......

DRAWING No.

~~SNOWY MOUNTAINS HYDRO-ELECTRIC AUTHORITY~~

GEOLOGICAL LOG OF DRILL HOLE

PROJECT Upper Cotter Dam Site "C" FEATURE

HOLE No. D.D. 3 CO-ORDINATES: E. M. , N. M. R.L. GROUND 2432.9 ft. 1

LOCATION West Bank, on site of proposed wall, near river level ANGLE FROM HORIZONTAL 52° DIRECTION 5 4° M

ROCK TYPE & DEGREE OF WEATHERING SHOWN IN CORE	DESCRIPTION	SIZE OF ~~R.L.~~ CORE	DEPTH & ~~SIZE OF CORE~~	LOG	LIFT & CORE RECOVERY (%)	STRUCTURES JOINTS, VEINS, SEAMS FAULTS, CRUSHED ZONES	NOTES WATER LEVEL (DATE) DRILLING WATER RETURN CHARACTER OF DRILL CUTTINGS
Fine grained quartzite Fresh	Mainly quartz grains with some black and brown particles. Biotite and chlorite described in thin sections	NM	5'6"		100 100 100 100 100	Open and closed joints with limonite staining Broken core 1'-2' Pieces ½"-1'. Thin mudstone ~~band~~ band at 3"	Depth to water varied from 1'5" to 8'6" during period 12/10/56 to 7/11/56
Fine grained quartzite Fresh	Similar to above but an increased number of black particles present, ~~mainly~~ biotite and chlorite	NM	17'4"		100 100 100 100	Open and closed joints with limonite staining. Joints 30° and 90°, with length of core, prominent Broken zone 6'-7' Core pieces ½" to 1', average 7".	
Fine grained quartzite Slightly weathered	Some weathered brown particles present. At 17'4", small thin lenses of silicified mudstone	NM	23'0"		100 100	Open and closed joints with limonite staining Very jointed and broken core from 17'4" - 20'6" Pieces minute to 3"	
Fine grained quartzite Fresh		NM	29'4"		100 100	Open and closed joints with limonite staining Joints 50°-75° to length of core. Pieces ½" to 9" Quartz veins	
Intraformational Sharpstone Layer (Sedimentary Breccia)	Fine-medium grained qtz. sandstone to qtz greywacke with broken mudstone layers				100		
Fine grained Quartz Sandstone and Quartzite Fresh (slightly weathered at broken zones)	Quartz grains and some brown and grey-green particles of altered ? mica and chlorite				100 100 100 100 100 100 100 100 100 100 100 100 100	Jointed, broken and weathered zones with limonite staining in joints. Quartz veining. Broken zones are at 55'-58'4", 50'-52', 44'-45', 42-43', 34', 27-28' Open and closed joints at 75° to 90° with core length. Pieces ½" to 8" mainly, some 14"	
Intraformational Sharpstone Layer Fine grained qtz. Sandstone to Quartzite	Fine-medium grained qtz sandstone to quartzite with pieces of siltstone Very silicified	NM NM	68'9" 71'0"		100	Joints with limonite staining Jointed. Pieces 3"	
Quartzite and Quartz Greywacke and Quartz Sandstone Very slightly weathered Fine grained mainly	Qtz. grains, weathered brown particles and unsorted material more noticeable. Faint bedding apparent. Some grey blue particles present. A finer grained bed apparent at 82'2"	N.M	88'6"		100 100 100 100 100	Jointed with limonite staining and core partly broken in places. Core contains (a) small veins and thin lenses of ? weathered sericite with small quartz needles at 70'-70'6" (b) drawn out veins, lenses, and fragments of mudstone at 72'-73'10" and 74'-74'6" Broken zone with broken silicified fragments and weathered friable sandstone fragments at 84'8" to 85'3" Open and closed joints at 60°-70° to length of core. Pieces minute to 10"	
Fine grained quartzite		N.M.	89'3"			Qtz veins & pockets - Slickensiding evident	
Fine grained highly silicified quartz sandstone to quartzite Fresh.	Quartz grains with some black grains of chlorite or altered mica Some zones ~~show~~ increased silicification	N M.	100'		100 100 100	Core wall jointed with limonite staining in joints Joints 60°-70° to length of core. Qtz veins, also. Pieces minute to 9"	

PERCOLATION TEST DEPTH (FT) FROM	TO	LOSS IN G.P.M.	PRESSURE (P.S.I.)	LENGTH OF TEST (min)
4'5"		2.3 G.P.M. (Pneumatic Packer) (Mechanical Packer U.S.)		5 Mins.
32'8"	39'6"	4.6 G.P.M. (Pneumatic Packer) 6.0 G.P.M. (Mechanical Packer)		5 Mins
52'8"	52'8"	3.4 G.P.M. (Pneumatic Packer) 6.0 G.P.M. (Mechanical Packer)		5 Mins.
73'10"	72'8"	1.9 G.P.M. (Pneumatic Packer) 2.2 G.P.M. (Mechanical Packer)		5 Mins
91'7"	91'7"			

DRILL No.
TYPE Mindrill

DRILLER B. Grech
COMMENCED 12/10/56
COMPLETED 7/11/56

ENGINEERING GEOLOGY SECTION
LOGGED John C. Fauceraher
SHEET No.
DRAWN
CHECKED
SUBMITTED

VERT. SCALE
SHEET OF
DRAWING No.

P

~~SNOWY MOUNTAINS HYDRO-ELECTRIC AUTHORITY~~

GEOLOGICAL LOG OF DRILL HOLE

PROJECT Upper Cotter Dam Site "C" FEATURE

HOLE No. D.D. 3 CO-ORDINATES: E. M. N. M. R.L. GROUND 2472.9 ft.

LOCATION West Bank on site of proposed wall near river level ANGLE FROM HORIZONTAL 52° DIRECTION 54°M

ROCK TYPE & DEGREE OF WEATHERING SHOWN IN CORE	DESCRIPTION	SIZE OF ~~B.C.~~ CORE	DEPTH ~~& SIZE OF CORE~~	LOG	LIFT & CORE RE-COVERY (%)	STRUCTURES JOINTS, VEINS, SEAMS FAULTS, CRUSHED ZONES	NOTES WATER LEVEL (DATE) DRILLING WATER RETURN CHARACTER OF DRILL CUTTINGS	PERCOLATION TEST DEPTH (FT) FROM	TO	LOSS IN G.P.M.	PRESSURE (P.S.I.)	LENGTH OF TEST (min)
Quartzite Fresh (slightly weathered at broken zones)	Quartz grains Some weathered brown particles and grey particles. Qtz veins Intraformational Sharpstone Layer at 115'10" to 116' 4" Fine grained silicified bands, in broken core at 109'-110'	N.M.	120'5"		100 100 100 100 100	Core very jointed with limonite staining in joints Core broken and slightly weathered from 105'-110' and 117'. Core very broken, shattered, weathered at 118'-118'4" Pieces minute to 11" Average 1"-3" Joints mainly 60°-90° to length of core		110'0"	112'5" 120'5"	3.0 G.P.M. (mech. Packer) 3.5 G.P.M. (rock Packer) Test section only		5 Mins. 5 Mins.

DRILL No.

TYPE Mindrill

DRILLER R. Grech

COMMENCED 12/10/56

COMPLETED 7/11/56

ENGINEERING GEOLOGY SECTION

LOGGED John C. Fenwaker

SHEET No.

DRAWN

CHECKED

SUBMITTED

VERT. SCALE

SHEET OF

DRAWING No.

P / E.G.

SNOWY MOUNTAINS HYDRO-ELECTRIC AUTHORITY

GEOLOGICAL LOG OF DRILL HOLE

PROJECT Upper Cotter Dam Site "C" FEATURE ....
HOLE No. D.D. 4 CO-ORDINATES: E.... M.... N.... M.... R.L. GROUND ....
LOCATION East Bank on site of proposed wall, near top water level. ANGLE FROM HORIZONTAL 70° DIRECTION 256° M.

ROCK TYPE & DEGREE OF WEATHERING SHOWN IN CORE	DESCRIPTION	SIZE ~~R.L.~~ OF CORE	DEPTH ~~SIZE OF CORE~~	LOG	LIFT & CORE RECOVERY (%)	STRUCTURES JOINTS, VEINS, SEAMS FAULTS, CRUSHED ZONES	NOTES WATER LEVEL (DATE) DRILLING WATER RETURN CHARACTER OF DRILL CUTTINGS	PERCOLATION TEST DEPTH (FT) FROM	TO	LOSS IN G.P.M.	PRESSURE (P.S.I.)	LENGTH OF TEST (min)
Highly silicified fine medium grained quartz sandstone to quartzite	Hard core. Dark streaks of probable bedding 50° from horizontal	Casing	5'0"		83	Jointing with faint limonite staining. A few quartz veins. Pieces in casing 2½" to 1'						
		N.X.	16'5"		100 100	Jointing often with a spacing of 5" to 6". Jointing slight at 20° - 25° with length of core. Some joints contain chalky white deposits. Broken zone 10' - 10'9"						
Blue-grey Quartzite Fresh.	Many black fragments in core. Core hard. 21'6" - 23' zone of increased silicification with quartz and some chloritic mudstone in fractures. 25' - 25'6" soft chloritic mudstone breaking core, also staining and bleaching of core in this area	N.X.	28'0"		89 81 66	From 21', increase in number of fractures running through core. Fractures with chloritic mudstone at 18'. Tight joints at 60° to length of core every ¾" from 18'5" to 19'5". Many fractures running for some length along core. Staining in fractures. Pieces mainly 4" to 9"						
Medium grained brown highly silicified quartz sandstone Mainly Fresh.	Heavily limonited and stained bed running at 40° to core length. ¼" thick medium soft and weathered. Otherwise good core and hard core	N.M	32'0"		100 100	Pieces of core 4" to 17"						
Fine grained highly silicified dark quartzite grading into a brown highly silicified qtz. sandstone to quartzite	Streaks of possible bedding at 50° to length of core for one foot 32' - 33'. Limonite stained bed and a silicified siltstone bed at 60° to length of core	NX	37'6"		100 86	Jointing variable 20° and 40° - 90° mainly, with limonite and black oxide staining. Pieces vary 2" to 10" average 4" to 6"						
Fine grained Grey-green Quartzite Fresh.	Some black grains in core. Core hard.	N.X	63'8"		100 100 100 100 100 100 100	Jointing often nearly parallel to length of core or at 20°. Some limonite staining in joints and on core. 41' - 42' broken core stained. 47½' to 49' very small white clay pockets in broken stained core. 60'6" to 62'6" 7" of core lost in beds similar to above. Pieces variable 1" to 2'. Average 2" to 4"						
Very highly silicified fine-medium grained brown qtz sandstone to qtz grading	Some weathered brown pockets in core otherwise good hard core.	N.X	68'0"		87	Pieces 2½" to 9". Jointing with limonite and black oxide staining. Core partly stained. Core lost 67' to 68'						
Very highly silicified quartz sandstone to quartzite		N.X	70'0"		77	Pieces 3" to 5" with limonite and black oxide stains						
Blue-Grey Quartzite Fresh	½" bed at 60° to length of core of brown sandstone 70'. Probable bedding traces at 60° to length of core 72-73. Good hard core. Some small black pockets on core	N.M	77'0"		100	Widely spaced joints. Average size of pieces 1'. 40° to 50° joints with length of core with limonite and black oxide stains						
Quartzite and areas of highly silicified fine grained quartz sandstone	Small black pockets on core. Core good, few joints	N.M	83'6"		100 100	Joints with limonite and black oxide staining at 25° and 70° with length of core. Few joints						
Blue-grey quartzite	Good hard core,	N.M	91'10"		100 100	Few joints. Slight limonite and black oxide staining. Pieces average 7" to 14"						
Highly silicified quartz sandstone to quartzite some mudstone lenses	91'10" Thin lenses of mudstone. 93'8" to 94'7" Broken zone with crumbled soft quartz sandstone, mudstone lenses and weathered soft white clay	N.M	94'7"		100	Jointing often at 45° to length of core. Limonite and black oxide staining. Pieces vary, minute at broken zone to 8"						
Quartzite and a small amount of highly silicified qtz sandstone.	Small chloritic siltstone patches at 97'3". Some small black pockets on core					20° and 40° jointing with length of core. Some minor tight fractures. Pieces mainly 6" to 1'. Limonite and oxide staining						

DRILL No. ....
TYPE Mindrill
DRILLER B. Grech
COMMENCED 3/1/57
COMPLETED 16/1/57

ENGINEERING GEOLOGY SECTION
LOGGED John C. Fowerahker
SHEET No. ....
DRAWN ....
CHECKED ....
SUBMITTED ....

VERT. SCALE ....
SHEET .... OF ....
DRAWING No. ....

SNOWY MOUNTAINS HYDRO-ELECTRIC AUTHORITY

GEOLOGICAL LOG OF DRILL HOLE

PROJECT Upper Cotter Dam Site 'C' FEATURE

HOLE No. D.D. 4 CO-ORDINATES: E. M. N. M. R.L. GROUND

LOCATION East Bank, on site of proposed wall, near top water level ANGLE FROM HORIZONTAL 70° DIRECTION 256° M.

ROCK TYPE & DEGREE OF WEATHERING SHOWN IN CORE	DESCRIPTION	SIZE ~~R.L.~~ OF CORE	DEPTH & ~~SIZE OF CORE~~	LOG	LIFT & CORE RECOVERY (%)	STRUCTURES JOINTS, VEINS, SEAMS FAULTS, CRUSHED ZONES	NOTES WATER LEVEL (DATE) DRILLING WATER RETURN CHARACTER OF DRILL CUTTINGS	PERCOLATION TEST DEPTH (FT) FROM	TO	LOSS IN G.P.M.	PRESSURE (P.S.I.)	LENGTH OF TEST (min)
		N.M.	102'4"		100							
Sedimentary Breccid Bed.	Weathered chalky siltstone Stringers and lenses of mudstone at 40° to 50° to core length brown quartz sandstone, highly silicified quartz sandstone quartzite. 102'4" to 103'4" the core is badly broken. From 109' – 116'6" very broken quartz sandstone. Thin mudstone bed at 111' running 50° to core length. Generally core broken, crumbled and also stained and weathered in part	N.M	111'6"		100 100	Core broken and crumbled many small fractures and close jointing experienced towards base of section. All joints with limonite and black oxide staining, Pieces minute to 6"						
Quartzite					100	Jointing 40°-50° to length of core. Some close jointing and tight fractures in core Pieces vary ¼" to 9"						
	Core hard	NM	116'6"									
Qtz sandstone, qtzite and stringers of thin mudstone lenses.	Broken Core	N.M	116'10"			Small fractures and mudstone lenses causing broken core						
					100							
Quartzite and highly silicified brown quartz sandstone to quartz greywacke.	Good hard core Many brown grains in core Faint streaks at 50° to core length, probable bedding. 125'-126' Broken core, with quartz and increased silicification 133' 10" Stained bed at 50° to core length. 133'10" to 138' - fine grained grey green quartzite. 137' Sedimentary breccia bed contains soft thin mudstone lenses and wedges at 50° to core length.	N.M.	140'0"		100 100 100 100 100	Jointing varies often at 30° to 50° with length of core containing limonite and black oxide staining Jointing often every 3" edge but not breaking open on drilling Broken zones partly due to vertical jointing at 118'6" to 121', 123' to 124' 125'-126' Pieces from 2" up to 2'2" outside the above broken zones						

DRILL No.
TYPE Mindrill

DRILLER R. Grech
COMMENCED 3/1/57
COMPLETED 16/1/57

ENGINEERING GEOLOGY SECTION
LOGGED John C. Fowcroha
SHEET No.
DRAWN
CHECKED
SUBMITTED

VERT. SCALE
SHEET OF
DRAWING No.

P

SNOWY MOUNTAINS HYDRO-ELECTRIC AUTHORITY

GEOLOGICAL LOG OF DRILL HOLE

PROJECT Upper Cotter Dam Site "C" FEATURE

HOLE No. D.D. 5 CO-ORDINATES: E. M. N. M. R.L. GROUND

LOCATION East Bank on site of proposed wall near river level ANGLE FROM HORIZONTAL 90° DIRECTION Vertical Down

ROCK TYPE & DEGREE OF WEATHERING SHOWN IN CORE	DESCRIPTION	SIZE ~~R.L.~~ OF CORE	DEPTH & ~~SIZE OF CORE~~	LOG	LIFT & CORE RECOVERY (%)	STRUCTURES JOINTS, VEINS, SEAMS FAULTS, CRUSHED ZONES	NOTES WATER LEVEL (DATE) DRILLING WATER RETURN CHARACTER OF DRILL CUTTINGS	PERCOLATION TEST DEPTH (FT) FROM	TO	LOSS IN G.P.M.	PRESSURE P.S.I.	LENGTH OF TEST (min)
Quartzite and medium grained highly silicified quartz sandstone Fresh.	Good hard core Some fractures recemented with chloritic mudstone	Casing	10'0"		100, 100, 100, 100, 100, 100, 68, 100, 100, 100, 100	In casing size pieces vary 1" to 1' mainly 6" Jointing with limonite and black oxide staining often at 40°-60° with length of core.						
		N.M	30'11"		100, 100, 100, 100, 100, 100, 100	Many quartz veins 17' to 21' Until 25' jointing nearly parallel and at 40° to the length of core Many quartz veins are also nearly parallel to length of core. 25' - 30'11" jointing mainly 70° to length of core Pieces vary 1" to 2'2" average 6" to 7"						
Quartzite	Core fractured, partly broken	N.M.	32'0"		100	Quartz veins running at 60° to core length. Pieces minute to 9" Limonite stains on joints						
Quartzite Fresh	Good hard core	N.M	35'3"		100, 100, 100	Some close jointing with limonite staining at 70° with core length Qtz veins Pieces 2"-6"						
Brown quartzite and silicified qtz sandstone Slightly weathered	Broken brown stained core. Some grains weathered	N.M.	38'6"		100	Fractured and broken core with quartz veins. Limonite and MnO staining Pieces ¼" to 4"						
Quartzite and some highly silicified quartz sandstone Mainly fresh	Areas in core show increased quartz content and silicification. Bedding at 60° to length of core. Good hard core	N.M	45'6"		100, 100, 100	Faint limonite and black oxide staining and very thin weathered clay deposits in joints Many quartz veins in core Pieces 2" to 1' mainly Some jointing parallel to bedding at 60° to length of core						
Quartzite and brown silicified qtz sandstone	Small bleached silt deposits between joints in broken zones	N.M.	47'2"		100	Close jointing with limonite and black oxide stains Qtz. veining						
Quartzite and brown silicified quartz sandstone	Bedding and very thin mudstone lenses at 60°-65° to core length Bleached zones in core	N.M	50'0"			Quartz veins. Some black oxide deposits in fractures and along borders of bleached zones						
Grey quartzite fresh to slightly weathered	Broken and fractured core hard pieces. Some bleached zones	N.M.	53'6"		100, 100, 100	Fractured zones with quartz veins and white soft clay deposits in fractures as well as limonite and black oxide stains. Pieces ¼" to 5"						
Blue-Grey Quartzite Fresh.	56'1" Thin silicified siltstone bed at 50° to length of core Fine-medium quartz grains often fractured across grains 58' white bleached zones at 65° to length of core 65'10" white bleached zones at 60° to core length. Some white mottling on core Good hard core mainly 55' to 55'6" cross bedding in core	N.M	69'7"		100, 100, 100	Qtz veins running down core at 20° Jointing often at 70° and also nearly parallel with length of core. All joints with limonite and black oxide staining often very faint. Pieces 2" to 1' average 4" to 6"						
Quartzite and lenses of brown qtz. sandstone	Broken core partly weathered	N.M	71'7"		100, 100	Broken, close jointed and fractured Limonite stains in joints and on parts of core. Pieces 1" to 6"						
Quartzite	Hardcore. White and light brown mottling on core. Some small weathered brown grains	NX	74'4"		100, 80	Quartz veining and cemented fractures						
Quartzite Fresh.	Hard core, some areas of increased silicification and quartz veining also some areas with increased number of small brown weathered grains. Thin mudstone lenses at 83'4" Core broken 76'3"-78'3" and 79'8" - 80'4"	NX	85'0"		100, 100, 100, 0, 100, 74, 100, 100	Core pieces vary up to 14" Limonite and Black Oxide staining Jointing variable some 40° some 90° with length of core. Some core lost with NX drilling.						

DRILL No.
TYPE Mindrill

DRILLER E. Wightman
COMMENCED 27/2/57
COMPLETED 18/3/57

ENGINEERING GEOLOGY SECTION
LOGGED John C. Fowerake
SHEET No.
DRAWN
CHECKED
SUBMITTED

VERT. SCALE
SHEET ... OF ...
DRAWING No.

P / F.G.

SNOWY MOUNTAINS HYDRO-ELECTRIC AUTHORITY

GEOLOGICAL LOG OF DRILL HOLE

PROJECT Upper Cotter Dam Site "C" FEATURE
HOLE No. D.D. 6 CO-ORDINATES: E. M. N. M. R.L. ~~GROUND~~ COLLAR 2500.2 ft.
LOCATION West Bank on site of proposed wall ANGLE FROM HORIZONTAL 77° DIRECTION 270° M.

ROCK TYPE & DEGREE OF WEATHERING SHOWN IN CORE	DESCRIPTION	SIZE OF ~~R.C.~~ CORE	DEPTH ~~& SIZE OF CORE~~	LOG	LIFT & CORE RECOVERY (%)	STRUCTURES JOINTS, VEINS, SEAMS CRUSHED ZONES	NOTES WATER LEVEL (DATE) DRILLING WATER RETURN CHARACTER OF DRILL CUTTINGS	PERCOLATION TEST DEPTH (FT) FROM	TO	LOSS IN GPM	PRESSURE	LENGTH OF TEST (min)
Hornfels Marker Bed. Fresh to slightly weathered	Hard "flinty" ashstone or claystone Broken due to close joints		2'8"			Closely jointed with limonite staining. Broken nature due to close joints. Pieces ¾" to 4"						
4" claystone weathered and 6" of red qtz. sandstone	Soft Core medium hard Pyrites	Casing	3'3"		80	Broken due to weathering at base of marker bed						
Quartzite Fresh	Core hard, but broken at some zones where close jointed. Core at these zones softer and weathered.	N.M.	14'2"		85, 100, 100, 100	Core well jointed with limonite staining. Joints and possible bedding at 50° to length of core. Joints running parallel to core also 5" mudstone bed at 7'						
Intraformational Sharpstone Layer Weathered	Qtz. sandstone and silicified siltstone lenses and wedges Broken and crumbled core	N.M.	16'0" 17'4"		100	Limonite staining in core and joints. Sedimentary breccia causing broken core						
Yellow brown qtz sandstone. Weathered	Qtz. sandstone and fine grained siltstone beds. Broken					Broken core with limonite staining. Bedding and joints						
Quartzite Fresh	Hard core. Pyrites present	NM	20'2"			Jointing 20° across core. Broken 18'6"						
Qtz sandstone and siltstone. Weathered	Soft core Brown staining				100	Soft beds and lenses causing broken core on drilling						
Blue to white Quartzite mainly fresh (except in broken zones)	Core hard. Some thin fine grained beds at 70° to length of core. also joints Some broken and weathered zones.	N.M	28'0"		100	Joints mainly 20° and 65-70° to length of core. Core broken 22½' to 23'3", 24', 25'-25'3", 26½', 27'. Joints with limonite MnO chloritic mudstone coating and weathered clay inside						
Quartzite	Hard with several medium-hard broken zones slightly weathered felspathic grains present in quartzite Quartz greywacke and weathered brown quartzite at broken zones	N.M.	39'0"		100, 100, 100, 100	Jointing with limonite staining. Prominent joints at 70° to length of core Many small fractures causing broken core Thin mudstone beds 29', 30'6". Pieces minute to 6" average 1" to 2"						
Quartzite and brown quartz sandstone, very weathered and crumbled.	Core medium-soft core crumbled in part quartz grains present	N.M	40'2"		100	Core and joints very stained with limonite. Pieces minute to 1½"						
Blue-grey quartzite fresh	Core hard	NM	46'6"		100, 100	Joints with limonite staining across core, at 25° mainly. Many small fractures. Broken core due to joints & drilling 42'-43'						
Quartzite	Medium-hard. Many small white felspathic grains in core slightly weathered	N.M.	50'0"		100, 100, 100	Many small fractures recemented with chloritic mudstone Fractures and joints with limonite. Pieces minute to 4"						
Quartzite Fresh	Core hard	N.M.	53'8"		100	Small pockets of clear quartz Jointing with limonite stains often at 70° to length of core 50' to 51'3" Broken.						
Quartzite and quartz greywacke	Many weathered brown grains. Broken core	N.M	58'0"		100, 100	Joints and fractures with limonite stains. Broken core due to fractures and mudstone pockets. Pieces minute to 3"						
Quartzite Fresh	Hard core white felspathic grains	N.M.	65'0"		100, 100	59'-62' Weathered clay film on joints. 63-64'8" near vertical joints running along core with limonite staining						
Quartzite Fresh	Quartzite. Blue-grey Good hard core 65' to 85' Quartzite with pockets and veins of quartz and soft chloritic blue-grey mudstone 85' to 88' Quartzite 88' to 90' 8"	N.M.	90'8"		100, 100, 100, 100	Jointing with limonite staining at 10° to 20° and 50° to 60°. Average size of pieces 8" to 2'. 65' Thin beds of soft-medium mudstone at 60° to length of core 67'3"-68' similar beds at 45° 73'4"-74' pockets of yellow white soft mudstone 65' to 68'. Thin quartz veins at 30°-60° to length of core						
Quartzite	Core broken with many small fractures. Softer veins and pockets of blue-grey chloritic mudstone and brown weathered sand grains. Also qtz frags	N.M.	95'0"		100, 100, 100, 100	Fractures with limonite and MnO staining. Broken core due partly to fractures and partly to soft pockets crumbling on drilling						
Quartzite	Very broken core due to fracturing. Pieces hard	N.M.	98'0"		100, 100	Limonite and MnO staining on all joints and fractures Pieces minute to 3"						

DRILL No.
TYPE Miadrill

DRILLER Z. Dvorak
COMMENCED 1/2/57
COMPLETED 9/2/57

ENGINEERING GEOLOGY SECTION
LOGGED John C. Fowerdker
SHEET No.
DRAWN
CHECKED
SUBMITTED

VERT. SCALE
SHEET ..... OF .....
DRAWING No.

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FG

SNOWY MOUNTAINS HYDRO-ELECTRIC AUTHORITY

GEOLOGICAL LOG OF DRILL HOLE

PROJECT Upper Cotter Dam Site "C" FEATURE

HOLE No. DD 6 CO-ORDINATES: E M , N M R.L. ~~GROUND~~ ~~COLLAR~~ 2500.2 ft

LOCATION West Bank on site of proposed wall ANGLE FROM HORIZONTAL 77° DIRECTION 270° M

ROCK TYPE & DEGREE OF WEATHERING SHOWN IN CORE	DESCRIPTION	SIZE OF ~~R.L.~~ CORE	DEPTH & ~~SIZE OF CORE~~	LOG	LIFT & CORE RE-COVERY (%)	STRUCTURES JOINTS, VEINS, SEAMS FAULTS, CRUSHED ZONES	NOTES WATER LEVEL (DATE) DRILLING WATER RETURN CHARACTER OF DRILL CUTTINGS	PERCOLATION TEST DEPTH (FT) FROM	TO	LOSS IN GPM	PRESSURE (P.S.I.)	LENGTH OF TEST (min)
Quartzite Fresh	Hard fresh core with thin mudstone beds at 55° to length of core	N.M.	110'0"		100 100	Jointing mainly at 35° and 60° to length of core with limonite and MnO staining in joints 102'3" Thin partly silicified mudstone bands at 55° to length of core. 107'6"–107'9" Coarser grained bed with brown and white felspathic, weathered, soft grains. At 107'9" band of silicified mudstone ½" thick at 55° to length of core						

DRILL No.

TYPE Mindrill

DRILLER Z. Dvorak

COMMENCED 1/2/57

COMPLETED 9/2/57

ENGINEERING GEOLOGY SECTION

LOGGED John C. Foweraker

SHEET No.

DRAWN

CHECKED

SUBMITTED

VERT. SCALE

SHEET OF

DRAWING No.

P
56

SNOWY MOUNTAINS HYDRO-ELECTRIC AUTHORITY

GEOLOGICAL LOG OF DRILL HOLE

PROJECT *Upper Cotter Dam Site "C"* FEATURE

HOLE No. *D.D. 7* CO-ORDINATES: E. M. N. M. R.L. GROUND *2542.3 ft*

LOCATION *West Bank on site of proposed wall* ANGLE FROM HORIZONTAL *90°* DIRECTION *Vertical Down*

ROCK TYPE & DEGREE OF WEATHERING SHOWN IN CORE	DESCRIPTION	SIZE OF ~~R.L.~~ CORE	DEPTH & ~~SIZE OF CORE~~	LOG	LIFT & CORE RECOVERY (%)	STRUCTURES JOINTS, VEINS, SEAMS FAULTS, CRUSHED ZONES	NOTES WATER LEVEL (DATE) DRILLING WATER RETURN CHARACTER OF DRILL CUTTINGS	PERCOLATION TEST DEPTH (FT) FROM	TO	LOSS IN G.P.M.	PRESSURE P.S.I.	LENGTH OF TEST (min)
Quartzite and quartz sandstone and some quartz greywacke weathered red and brown grains in core	Some core on borderline between quartz sandstone and quartz greywacke. Highly silicified in part with quartz grains and some brown weathered grains. Core hard.	Casing NM	4'8" 21'0"		82 100 100 100 100 100	Joints with limonite and black oxide staining. Many vertical and near vertical joints. Close jointing causing broken zones 16'–17' and 19'–20'. Size of pieces vary from minute to 19 inches						
Quartzite and Quartz Sandstone. Fresh quartz grains, weathered brown grains in core	Quartz sandstone, silicified, with varying amounts of weathered brown grains present. Hard core	NM.	32'5"		100 100 100 100 100	Jointing with limonite and MnO staining. Joints vertical and 20° from vertical, mainly close jointing causing broken core at 21'–22' and 24'. Pieces vary, average 6 inches						
Quartz Sandstone. Some weathered grains	Fine-medium grained qtz. sandstone stained light brown	N.M.	35'10"			Jointing and faint bedding apparent at 20° from horizontal. Also 20° from vertical-jointing. Thin mudstone band at 32'5"						
Intraformation Sharpstone Layer to 36'4" and quartz sandstone and quartzite, weathered, to 37'	Lenses and angular fragments of fine grained quartz sandstone and mudstone in sedimentary breccia. Soft in part	N.M.	37'0"		100 100 100 100	Sedimentary breccia breaking up and crumbling core. Limonite and oxide staining on core and in joints						
Hornfels Marker Bed – fresh. Some small weathered zones	Claystone or ashstone. Bottom 4" weathered, broken claystone	N.M.	43'9"		100	Jointing and bedding at 20° from horizontal. Pieces up to 2". Jointing causing broken core 37'5"–38'. Weathered & broken zone 43'5"–44'9"						
Quartz sandstone and quartz greywacke. Some grains weathered	Qtz grains and weathered red grains present. Hard core	N.M.	45'8"			Open and closed joints with limonite and black oxide staining. Near vertical joints. Pieces 2"–8"						
Quartzite Fresh.	Fine grained with numerous white-grey felspathic? grains present. Broken zone with thin mudstone lenses 53'–54'	N.M.	54'4"		100	Joints with limonite and black oxide staining. Joints vertical and 0°–20° from horizontal. Thin mudstone lenses causing broken core 53'–54'. Pieces 6" to 22"						
Intraformational Sharpstone Layer Weathered	Fine grained quartz greywacke and silicified siltstone lenses. Core broken and partly soft	N.M.	55'7"		100	Jointing vertical and stained. Soft mudstone lenses causing core to break up on drilling						
Quartzite and fine quartz sandstone Fresh (some weathering in fractured zones)	Several broken zones with staining on core. Core mainly hard. Some mudstone bands and thin lenses. Pyrites in core	N.M.	79'0"		100 100 100 100 100 100 100 100 97 100	Jointing with limonite staining both vertical and 15°–20° to length of core. Some silicification and vertical quartz seams. From 65' to 79' jointing at 65° with length of core. Core broken due to close joints and mudstone bands and lenses at:– 56'6", 57'–58', 67'–68', 71½'–73', 74'–77'. Average pieces 4"–5" but vary from minute to 10"						
Quartzite (some grains with brown weathered appearance)	Core hard		87'5"		100 100	Quartz Veins. Jointing breaking core into 4" pieces. Joints mainly at 40° to length of core.						
Hard quartzite fractured slightly weathered	Fractured in part and recemented with softer chloritic mudstone	N.M.	89'7"		100	Broken core caused partly by fractures partly by mudstone. Pieces 4" to minute. Banding across core at 60° to length of core						
Quartzite portions of core show some grains with brown weathered appearance. Elsewhere core fresh	Core hard. Thin mudstone beds, and jointing, running across core at 40°, at 94'7" to 97'6"				100 100 100	Limonite and black oxide staining in joints. Jointing mainly at 70° to length of core. Many thin quartz veins running across core. Broken zones 90'–91', 94'7"–97'6"						

DRILL No.
TYPE *Mindrill*

DRILLER *R. Grech* *Z. Dvorak*
COMMENCED *20/1/57*
COMPLETED *30/1/57*

ENGINEERING GEOLOGY SECTION

LOGGED *J.C. Eowerdaker*
SHEET No.
DRAWN
CHECKED
SUBMITTED

VERT. SCALE
SHEET ... OF ...
DRAWING No.

P

SNOWY MOUNTAINS HYDRO-ELECTRIC AUTHORITY

GEOLOGICAL LOG OF DRILL HOLE

PROJECT Upper Cotter Dam Site "c" FEATURE ....

HOLE No. D. D. 7 CO-ORDINATES: E ...... M ...... N ...... M ...... R.L. ~~GROUND~~ COLLAR 2542.3 ft

LOCATION West Bank on site of proposed wall ANGLE FROM HORIZONTAL 90° DIRECTION Vert. Down

ROCK TYPE & DEGREE OF WEATHERING SHOWN IN CORE	DESCRIPTION	SIZE OF ~~R.L.~~ CORE	DEPTH & ~~SIZE OF CORE~~	LOG	LIFT & CORE RECOVERY (%)	STRUCTURES JOINTS, VEINS, SEAMS FAULTS, CRUSHED ZONES	NOTES WATER LEVEL (DATE) DRILLING WATER RETURN CHARACTER OF DRILL CUTTINGS	PERCOLATION TEST DEPTH (FT) FROM	TO	LOSS IN G.P.M.	PRESSURE P.S.I.	LENGTH OF TEST (min)
Quartzite some grains brown. weathered appearance. Elsewhere fresh	Core hard		106'		100 100	101' Small fractures filled with white clay Broken due to close jointing 102'-102'6"						
Quartzite some grains brown, weathered, some white Elsewhere fresh core.	Core hard with broken zone at 107' to 108' due to near vertical joints with chloritic mudstone		110'		100 100	all joints with limonite staining. Qtz. veins						
Blue-grey Quartzite Fresh (some white grains, and brown grains with weathered appearance in core)	Core Hard Some zones of broken core due to jointing and mudstone breaking up on drilling		129'		100 100 100 100 100 100	all joints with limonite staining. Many joints at 65° to length of core Pieces vary minute to 9" average 3"-4" Band of silicified mudstone at 112'3" Broken zone at 114' due to jointing and chloritic mudstone breaking on drilling 119' lenses of silicified mudstone causing broken core 124½'-126' Broken due to joints						
Pale brown Quartzite Some brown grains appear weathered.	Core very broken due to jointing and small fractures. Hard but broken		136'1"		100	Joints and part of core stained with limonite. Many small fractures running across core at 25° Broken zones 129'-130', 133'-134' due to jointing and qtz veining Pieces average 2"-6"						

DRILL No. ....

TYPE Mindrill

DRILLER ~~Z. Dvorak~~ R. Grech

COMMENCED 20/1/57

COMPLETED 30/1/57

ENGINEERING GEOLOGY SECTION

LOGGED J. C. Fowcraher

SHEET No. ....

DRAWN ....

CHECKED ....

SUBMITTED ....

VERT. SCALE ....

SHEET ...... OF ......

DRAWING No. ....

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SNOW MOUNTAINS HYDRO-ELECTRIC AUTHORITY

GEOLOGICAL LOG OF DRILL HOLE

PROJECT Upper Cotter Dam Site "C" FEATURE

HOLE No. D.D. 8 CO-ORDINATES: E. M. N. M. R.L. GROUND

LOCATION West Bank upstream of site of proposed wall between DD 6 & 7 ANGLE FROM HORIZONTAL 38° DIRECTION 27° M.

ROCK TYPE & DEGREE OF WEATHERING SHOWN IN CORE	DESCRIPTION	SIZE ~~R.L.~~ OF CORE	DEPTH & ~~SIZE OF CORE~~	LOG	LIFT & CORE RECOVERY (%)	STRUCTURES JOINTS, VEINS, SEAMS FAULTS, CRUSHED ZONES	NOTES WATER LEVEL (DATE) DRILLING WATER RETURN CHARACTER OF DRILL CUTTINGS	PERCOLATION TEST DEPTH (FT) FROM	TO	LOSS IN GRM	PRESSURE (P.S.I.)	LENGTH OF TEST (min)
Quartzite Fresh	Quartz grains and brown and white grains. Core hard	Casing	3'9"			Jointing mainly 40°-50° with length of core some limonite staining average size in N.M. core 4" to 6"						
		N.M	9'0"									
Quartzite	Some brown staining in core adjacent to badly jointed areas. Core hard, with brown and black grains present. 11'-12' brown qtz sandstone. 12'-13' bedding at 50° with length of core	N.M.	16'0"			Quartz veining. Jointing mainly at 40°-50° to length of core. Pieces very minute to 6" average pieces 4"						
Fine-medium grained quartz sandstone to quartzite	Broken core, stained light brown in parts. Hard. Some brown grains and many white grains present. Core shows fracturing across a majority of quartz veins. Lens of silicified mudstone medium-soft at 25'4"	N.M	30'6"			Quartz veins running steeply across core. Many small fractures in core from 21' onwards. Jointing mainly 40°-60° with limonite and black oxide staining. Pieces mainly 4" to 6"						
Brown Quartzite	Quartz grains with some white and brown material present	N.M.	32'8"			Broken and fractured core with limonite and black oxide staining. Pieces minute to 3"						
Light brown quartzite passing into blue-grey quartzite	Very broken core due to fractures. Some very thin green silicified lenses. Core hard	N.M.	39'7"									
Sedimentary breccia Weathered	Fine grained quartzite, qtz sandstone, siltstone. Core very broken and shattered, with lenses of the above	N.M.	40'9"			Core in small fragments. Pieces minute to 1". Stained, broken and shattered						
Highly silicified fine grained blue-grey qtzite passing into marker bed	Core fractured limonite staining. Broken, badly fractured zone 42'8"-43'2"	N.M.	43'2"			Quartz veins 60° to core length. Pieces average 2" to 4"						
Hornfels Marker Bed grading into very fine grained dark coloured quartzite	Core with many fractures broken in part, often stained brown	N.M.	51'3"		100% Core Recovery	Many small fractures, limonite staining. Quartz veining						
Quartzite fine grained	Many fractures throughout core. Some thin lenses of mudstone. Core partly broken. Hard. Core contains quartz grains, white, and brown grains.	N.M.	65'4"			Quartz veining 40° to 50° to length of core. Joints with limonite and black oxide staining. Orange-brown clay in joints 56'6" to 57'6". Many fractures causing broken core. Pieces very minute to 9"						
Quartzite	Weathered siltstone pockets causing the broken core	N.M.	67'0"			Limonite and black oxide staining pieces minute to 3"						
Quartzite fine grained	Very broken core 68½' to 70'	N.M	70'0"			68'6" possible slickensiding on 65° joint plane. Core broken and fractured with limonite and MnO						
Quartzite	Badly fractured, partly recemented	N.M.	71'6"			Broken core pieces minute to 3½"						
Sandstone and weathered mudstone	Broken, soft, blue grey and brown mudstone lenses		72'9"			Pieces minute to 2"						
Quartzite	Broken core, weathered adjacent to fractures	N.M.	75'0"			Many small fractures often vertical with limonite staining & partly filled with sand and mudstone						
Quartzite weathered	qtz sandstone and clay pockets	N.M.	77'2"			Core broken, crumbled, stained. Pieces to 2"						
Quartzite, fractured	hard, with one thin mudstone lens	N.M.	78'0"			Qtz. veining broken & crumbled core						
Quartzite	Core coloured white in part. Broken core due to fractures	N.M.	79'6"			Broken core, small fractures stained with limonite in fractures						
Quartzite stained brown, some brown quartz sandstone	Core hard, but very jointed broken, and shattered into small angular fragments. 80'6" Thin flaky mudstone band at 40° to length of core. 87' ½" thick lens of silicified siltstone. 88'6" Thin bands bleached white. 89' Thin silt. bands also 40°. 89'6" Stained, weathered quartz sandstone and thin siltstone beds at 50° to length of core. 93'-93'6" Broken and crumbled core, some quartz fragments. 94'-94'10" Thin flaky beds ⅛" thick. Core soft, weathered. Some Pyrite. 96'10" and 97'3" bedding in brown quartz sandstone at base of section	N.M	97'3"			Core broken, pieces hard and angular and limonite stained. Core very fractured and closely jointed at 40° to length of core and also parallel with length of core. Joints with white clay and black oxide staining. Pieces minute to 6" but mainly 2"-4" except at broken crumbled zones.						
Quartzite	Fractures and irregular stains on core	N.M	99'0"			Core has many small fractures. Pieces ½" to 6"						
Brown Quartz Sandstone	Broken partly weathered, siltstone lenses					Core fractured, crumbled. Pieces up to 2"						

DRILL No.

TYPE Mindrill

DRILLER Dvorak

COMMENCED 12th Feb '57

COMPLETED 21st Feb '57

ENGINEERING GEOLOGY SECTION

LOGGED J. C. Foweraker

SHEET No.

DRAWN

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VERT. SCALE

SHEET OF

DRAWING No.

P

SNOWY MOUNTAINS HYDRO-ELECTRIC AUTHORITY

GEOLOGICAL LOG OF DRILL HOLE

PROJECT *Upper Cotter Dam Site "C"* FEATURE

HOLE No. *D.D. 8* CO-ORDINATES: E. M. , N. M. R.L. GROUND

LOCATION *West Bank upstream of site of proposed wall between DD6 & 7* ANGLE FROM HORIZONTAL *38°* DIRECTION *27° M*

ROCK TYPE & DEGREE OF WEATHERING SHOWN IN CORE	DESCRIPTION	SIZE ~~R.L.~~ OF CORE	DEPTH ~~& SIZE OF CORE~~	LOG	LIFT & CORE RECOVERY (%)	STRUCTURES JOINTS, VEINS, SEAMS FAULTS, CRUSHED ZONES	NOTES WATER LEVEL (DATE) DRILLING WATER RETURN CHARACTER OF DRILL CUTTINGS	PERCOLATION TEST DEPTH (FT) FROM	TO	LOSS IN G.P.M.	PRESSURE P.S.I.	LENGTH OF TEST (min)
Grey Green Quartzite Fresh.	*Core broken with many fractures 102'9" to 103'9" and 104'6" Core hard*	*N.M.*	*111'0"*		*100% Core Recovery*	*Joints at 40° and also parallel with length of core, Joints with limonite and black oxide staining Some joints contain a clay. Pieces minute to 16 inches. Average 4"*						
Blue Grey Quartzite Fresh.	*Good core, hard, bleached white adjacent to fractures from 111' to 115'*	*N.M.*	*117'1"*			*Pieces mainly 4" to 6" Jointing 30° to 40° with length of core. Quartz veins at 40° with length of core.*						
Grey Green Quartzite Fresh.	*Core hard with some light-brown staining 117'-119'*	*N.M.*	*120'8"*			*Jointing at 50° to length of core mainly. Pieces mainly 4" long*						
Grey Green Quartzite soft mudstone at 10°	*with pockets and lenses, drawn out, at to length of core*	*N.M*	*122'4"*			*Core broken along irregular fractures with limonite & black oxide stains Pieces 4"-8"*						
Blue Grey Quartzite	*Hard core*	*N.M*	*123'6"*			*Joints 45° and parallel with core Pieces 2"-6"*						
Quartzite	*Core fragmented mainly hard some crumbled, Stained brown Broken core at 124', 127'4" 129-130, 130'4"*	*N.M*	*131'0"*			*Many small fractures causing the broken zones. Irregular fractures with limonite and oxide stains Some quartz veining. Dominant joint direction 50° to length of core. Pieces (excluding broken zones) 2"-4"*						
Quartzite	*Core showing fracturing but not breaking on drilling. Core stained adjacent to fractures, Blue-grey quartzite from 134' onwards.*	*N.M.*	*136'1"*			*Jointing with and without limonite and black oxide stains at 50° to length of core Increased number of quartz veins towards 136', running at 45° with length of core. Pieces, average size 4"-8"*						

DRILL No.

TYPE *Mindrill*

DRILLER *Dvorak*

COMMENCED *12th Feb '57*

COMPLETED *21st Feb '57*

ENGINEERING GEOLOGY SECTION

LOGGED *J. C. Foweraker*

SHEET No.

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SHEET ... OF ...

DRAWING No.

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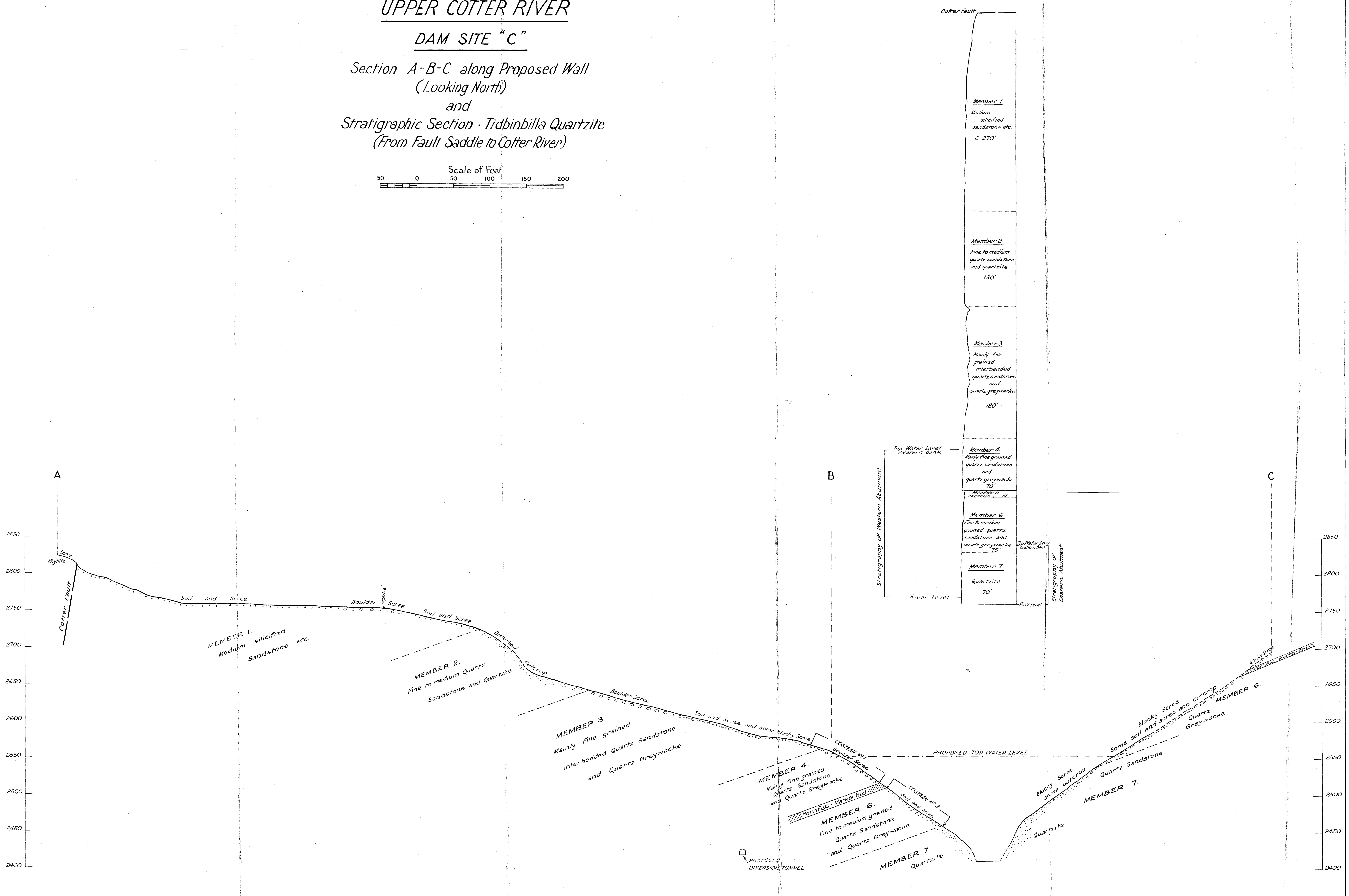
PROGRESS GEOLOGICAL PLAN
DAM SITE "C"
UPPER COTTER RIVER
Scale:- 50 Feet to 1 Inch.
Bureau of Mineral Resources. Canberra.
July 1956.
Legend
Cow Flat Granite
Tidbinbilla-Quartzite (outcrops), qtz-sandstone, qtz-greywacke and quartzite.
Sheared siltstone and qtz-greywacke (Phyllite)
Hornfels Marker Bed
D.O. Disturbed Outcrops
B.S. Boulder Scree
S.S. Soil and Scree
Clearing for Main Camp
Granite Camp
Magnetic North
FAULT ZONE
MEMBER 1
MEMBER 2
MEMBER 4
MEMBER 5
MEMBER 6
MEMBER 7
River
BOUNDARY OF LANDSLIP
Blocky Scree
Plate 1

UPPER COTTER RIVER

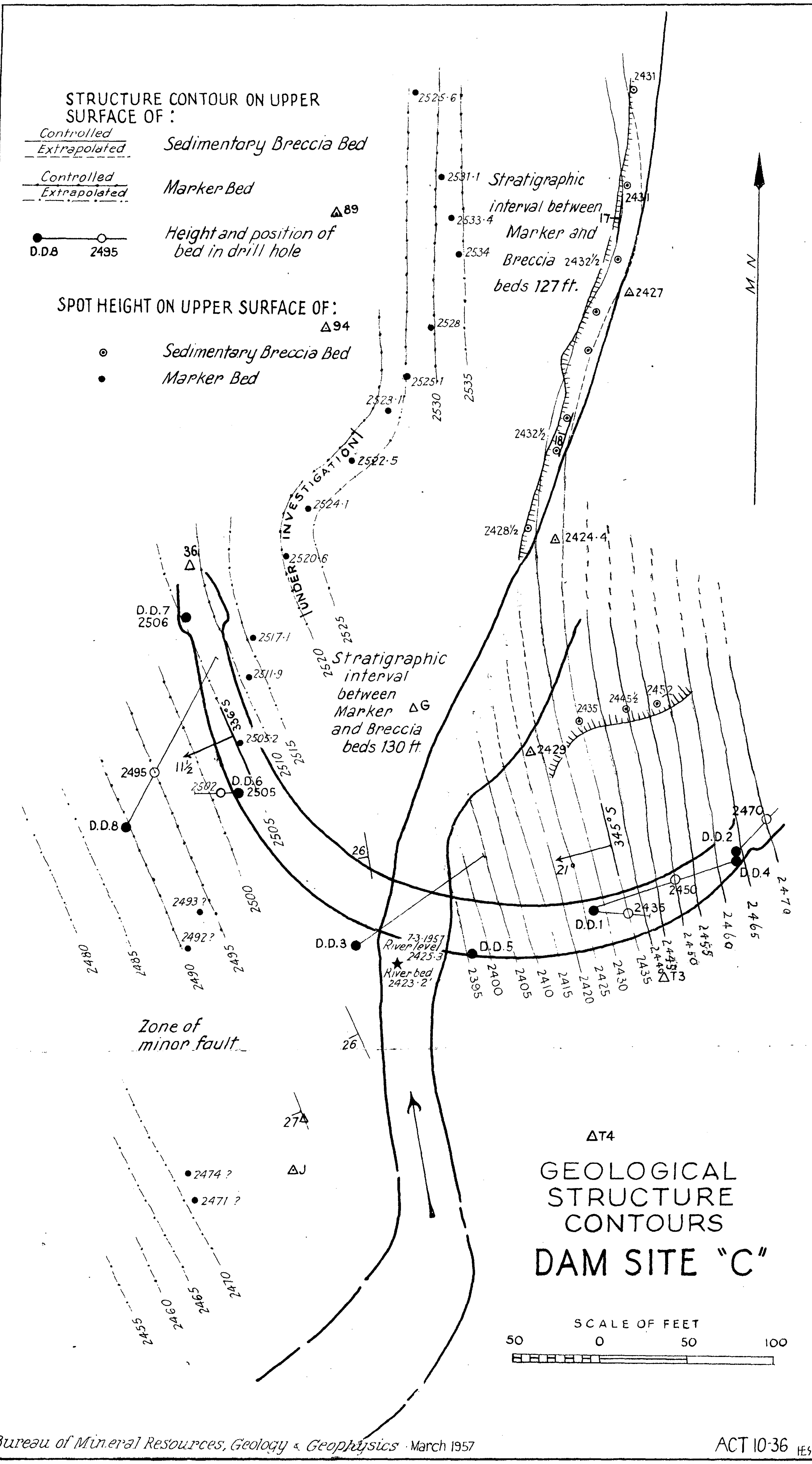
DAM SITE "C"

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



Bureau of Mineral Resources · Canberra. August 1956.

Plate 3



GEOLOGICAL STRUCTURE CONTOURS
DAM SITE "C"

SCALE OF FEET
50 0 50 100

Bureau of Mineral Resources, Geology & Geophysics · March 1957

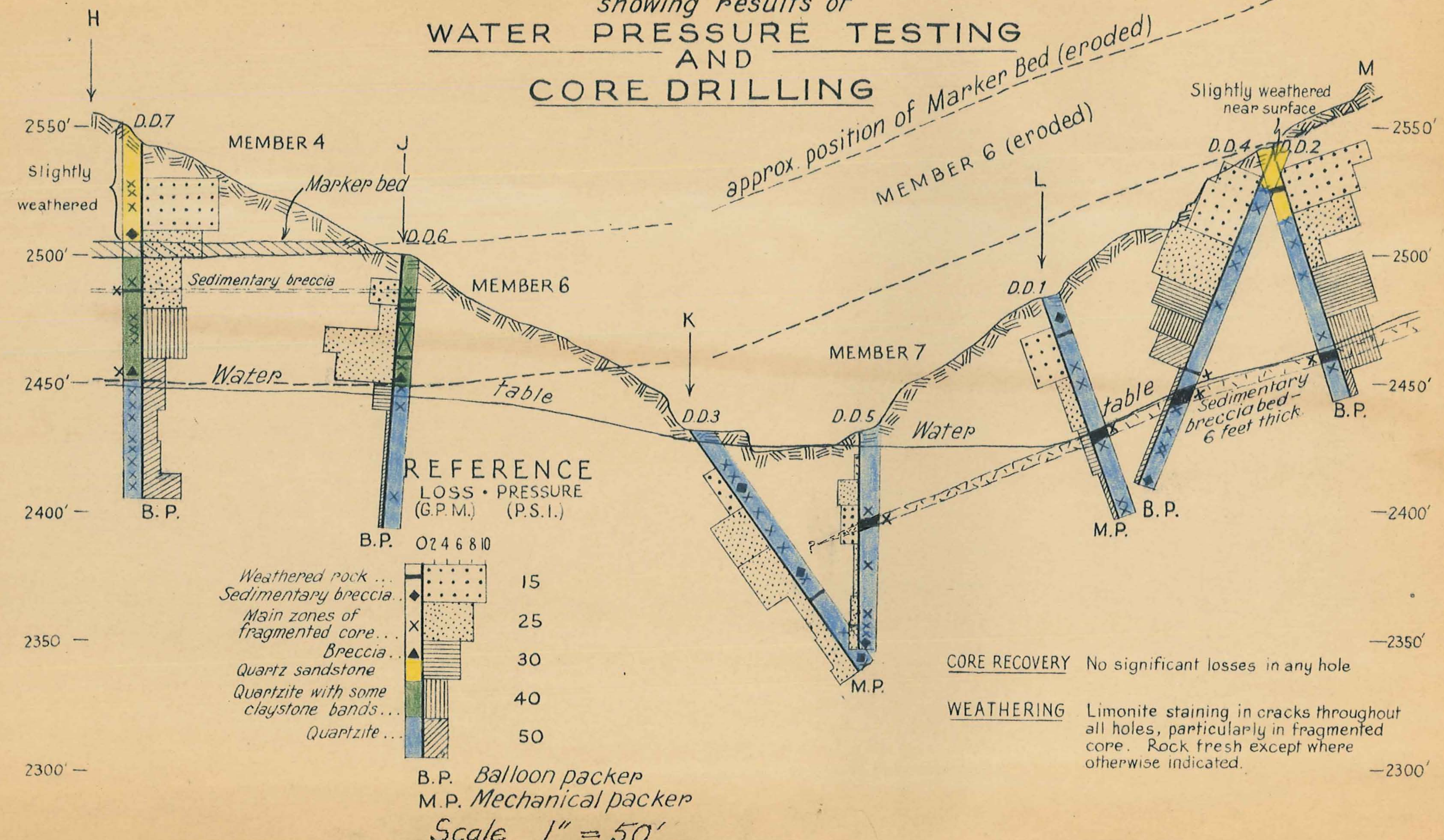
ACT 10-36 HES

Plate 4

UPPER COTTER DAM SITE "C"

Section (looking North) along proposed wall
(Diamond drill holes projected)
showing results of

WATER PRESSURE TESTING AND CORE DRILLING



CORE RECOVERY No significant losses in any hole

WEATHERING Limonite staining in cracks throughout all holes, particularly in fragmented core. Rock fresh except where otherwise indicated.

Bureau of Mineral Resources, Geology & Geophysics · March 1957.

ACT 10-35

HES

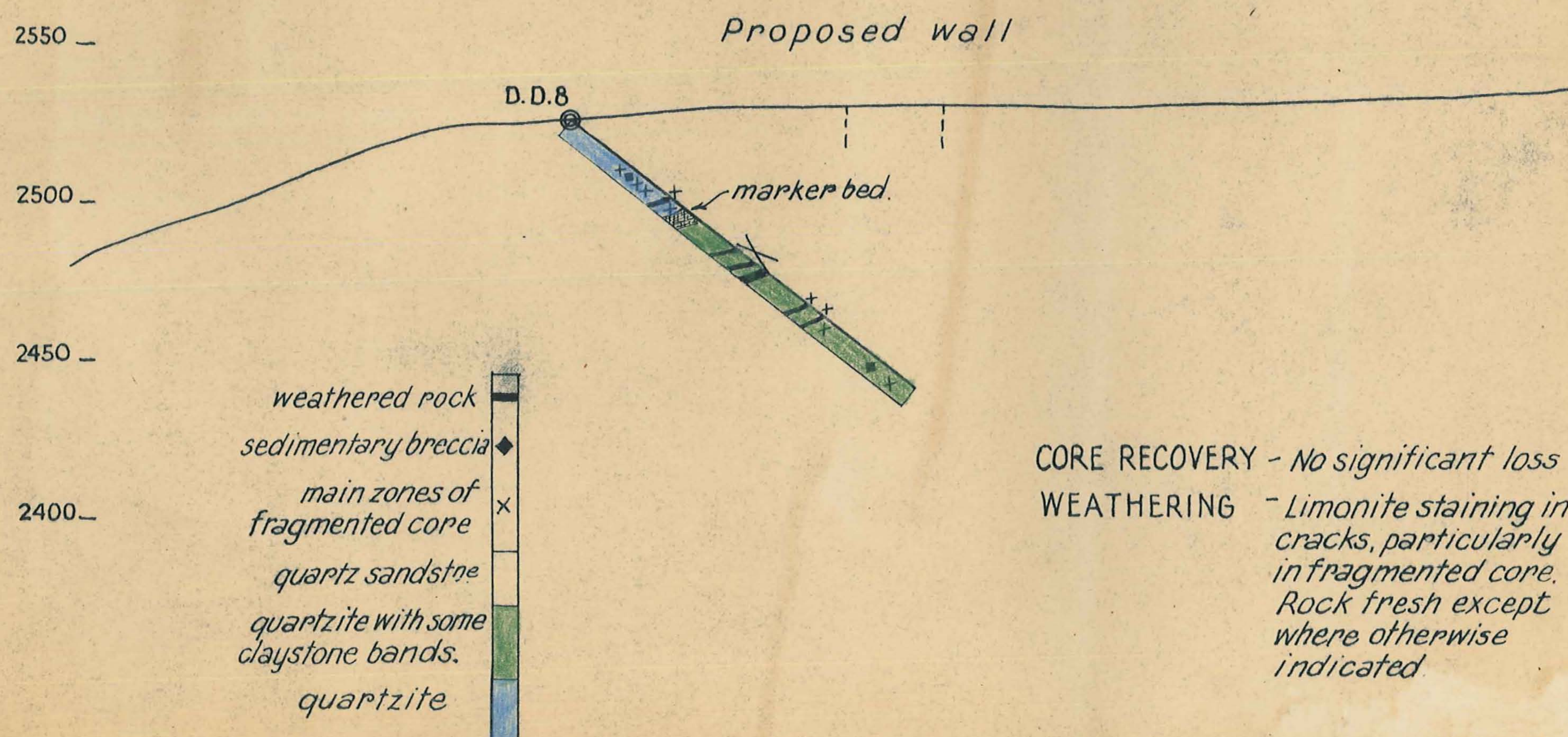
Plate 5

UPPER COTTER DAM SITE "C"

Section looking west along Diamond drillhole 8 showing results of core drilling

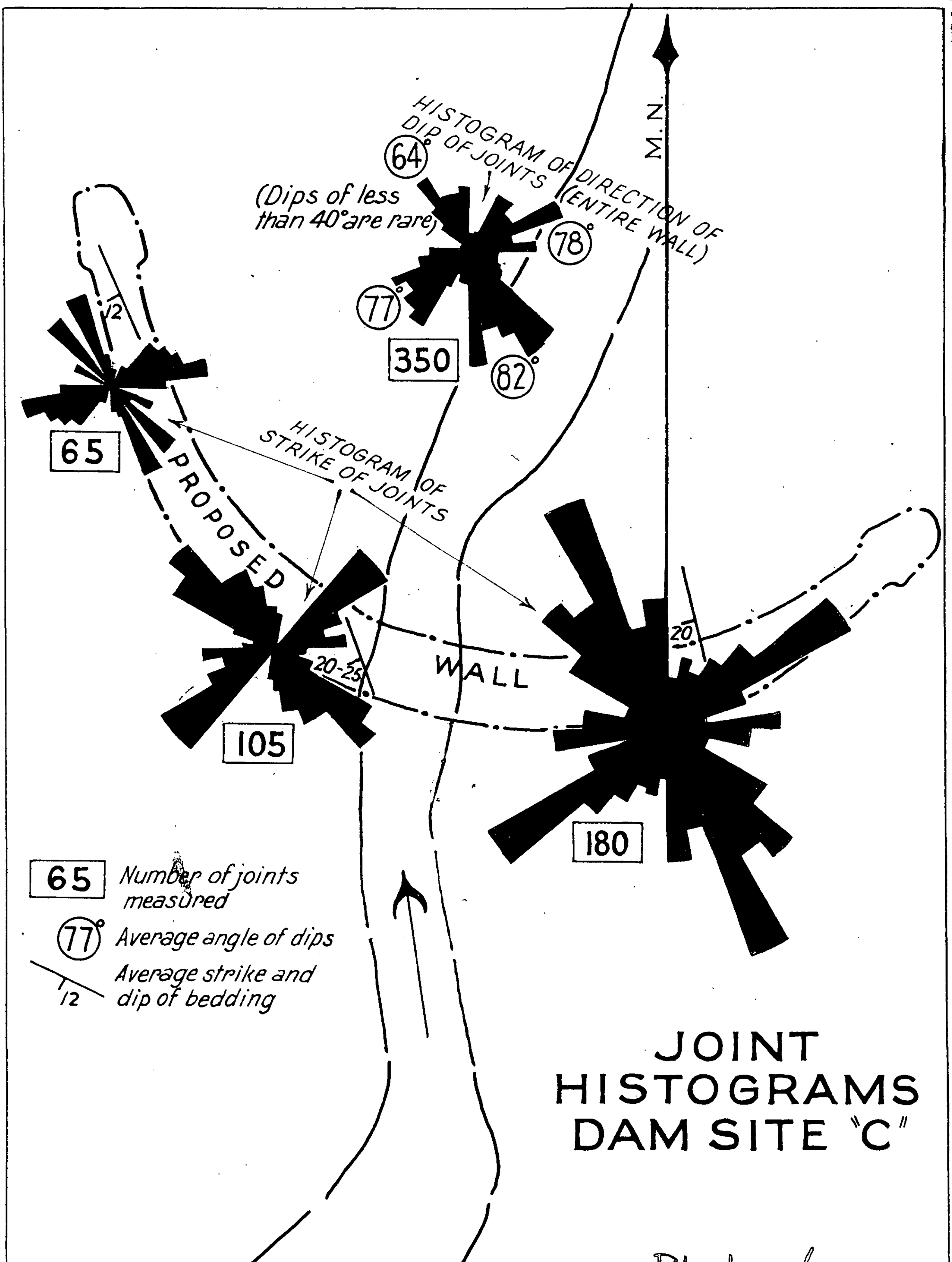
NO WATER TESTING DUE TO CAVING

Scale 1" = 50'



Bureau of Mineral Resources, Geology & Geophysics - Mar 1957.

A.C.T. 10-38



JOINT HISTOGRAMS DAM SITE "C"

Plate 6.

Bureau of Mineral Resources, Geology & Geophysics March 1957. ACT 10-37