GEOLOGICAL SURVEY REPORT

GS 1941/057

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TITLE DAM SITES ON THE BELUBULA RIVER, NEAR CANOWINDRA

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ACCOMPANYING PLANS 2 SHEETS

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41/1609 M.

Dam Sites on the Belubula River, near Canowindra.

by

E. J. Kenny

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At the request of the Water Conservation and Irrigation Commission and in accordance with your instructions, I visited Canowindra on the 4th and 5th inst. and examined proposed dam sites on the Belubula River. Mr. G. Huddleston, the Commission's Principal Engineer, Investigations, accompanied me, indicated the proposed sites, and discussed relevant problems in the Field.

The sites in question are grouped in two localities, known respectively as Cranky Rock and The Needles. Each group will be considered separately.

A. Cranky Rock Sites. Diagram A.

Five distinct sites were inspected in the vicinity of Cranky Rock about 12 miles north-easterly from Canowindra near the confluence of Canomodine Creek and the Belubula River. The sites are within Parish Chaucer, County Bathurst, and Parishes Collett and Canomodine, County of Ashburnham. For convenience the sites may be known as Nos. 1 to 5 in order of succession downstream.

Rocks exposed in this neighbourhood comprise, in ascending order, limestones, shales, tuffs and tuffaceous sandstones with thin calcareous beds and shale partings. The beds are arranged in the form of a broad anticline, the axis trending in a north-south direction and the limbs dipping at angles of 20 to 25 degrees. This structural unit pitches southerly at a low angle so that the exposures of the lowermost beds - the limestones - are much more restricted on the south side of the river than on the north.

The strata are of Silurian age and are partly indurated more especially in the tuffaceous members so that the shale partings are somewhat cherty.

No. 1 Site, Por. 96, Ph. Chaucer

This site is within tuffs and tuffaceous sandstone with thin calcareous beds, the strata possessing a general strike of N.10 deg. E and a dip easterly at angles of 20 to 25 deg.

Pronounced vertical joints trend N 60 deg. E. In the vicinity of the site the outcrops are fairly massive but more rapid intercalation of tuffs and shales is apparent upstream. Depth to bedrock beneath the alluvium does not appear excessive judging from the rock bars exposed in the river bed.

In my opinion this site offers attractive conditions for the founding of a masonry or earthwork dam. If a masonry structure is contemplated care should be taken to

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ensure that the foundations are placed sufficiently far upstream to make certain that there will be no necessity to excavate in the main beds of shale which underlie the tuffs.

Nos. 2 and 3 Sites, Por. 101, Ph. Canomodine and Por. 20, Ph. Collett.

These sites are within limestone which is heavily jointed with much evidence of removal by solvent action from weathering agencies and water percolation.

In my opinion conditions in both these examples are distinctly unfavourable for dam foundations and abutments.

No. 4 Site. Por. 36, Parish Collett.

Tuffs and tuffaceous sandstones with intercalated shales outcrop here. The beds strike north-westerly and dip south-westerly, i.e. downstream, at a general angle of 25 deg. To the east of the site is a development of shales conformably underlying the tuffs and associated types.

In my opinion the downstream dip and the proximity of underlying shales are conditions which cannot be regarded as suitable for dam construction and the site must be rejected.

No. 5 Site. Por. 39, Parish Collett.

Massive tuffs and tuffaceous sandstones with very thin bands of shale (partly indurated) offer lithological conditions which appear more suitable than any of the other sites. However, structural features are not so promising. The beds trend N 15 deg. W. and dip downstream at angles of 20 to 25 degrees. Two main systems of jointing are in evidence, the first, striking N 60 deg. E and dipping upstream at 70 deg., the second, trending N 15 deg. W and dipping downstream at 45 deg.

The exposure is well above the main shale zone but there are some thin beds of shale intercalated with the tuffs immediately upstream of the site. Consideration must be given to the possibility of block movement upon the weaker shales with resultant instability. These aspects are more serious in the instance of a projected masonry structure but the site appears suitable for an earthworks dam.

The bedding and joint planes, though open where exposed to the attack of atmospheric agencies and undermining by erosion, may be expected to seal at no great depths to such an extent that no serious leakage from these sources may be anticipated. In any case amenability to pressure grouting is apparent.

B. The Needles Site Diagram B.

Situated about 20 miles easterly from Canowindra in the vicinity of por. 57, Parish Malongulli and por. 114, Parish Carlton, County of Bathurst, this site is within a gorge carved by the Belubula River in Devonian rocks which are seen to rest unconformably upstream on a basement of Silurian tuffs.

The Devonian rocks are all of sedimentary origin and comprise beds of conglomerate, sandstone and shale, in part sandy. Some of the sandstone of the upper beds is partly indurated and form a fine-grained semi-quartzite very similar to the Upper Devonian examples in the Western Division of the State.

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In descending order the stratigraphical succession from the top of the cliff overlooking the dam site is approximately as follows :-

Stratum	Thickness Ft.
Sandstone	20
Conglomerate	5
Sandstone	40
Conglomerate	10
Sandstone	20
Sandy shales	20
Conglomerate	10
Mainly sandy shales with thin beds of friable conglomerate (clayey matrix)	140
Sandstone	5
Conglomerate	5-6
Mainly shales in part sandy	80
Conglomerate	20
Silurian tuffs forming a basement to above.	

The upper 125 feet of sandstone and conglomerate forms the prominent cliffs bounding the gorge. These upper members are overlain downstream by less resistant rocks composed essentially of sandy clayshale which, in turn, give place westerly to a strong bar of conglomerate.

The sandstone is not massive but is disposed in a number of beds of 5 to 6 feet maximum thickness but so thin on some horizons as to possess a shaley structure. The matrix is usually very siliceous and semi-quartzitic.

Attitude of the beds is typically a meridional strike with a dip downstream of 15 deg. The main tension joints are aligned in a north-south direction and dip upstream at 75 deg. Another set of vertical joints is arranged parallel to the general direction of dip of the beds.

On the north side of the gorge the beds exhibit a gentle warp to give an open anticline and syncline. The axis of the fold appears to trend N.W.-S.E. so that similar folded conditions are not apparent in the cliffs to the south of the river. However, in the lower portion of the geological section on the left bank pronounced folding is exposed in shales which are relatively incompetent types between two stronger bars of conglomerate.

I am of opinion that this site is not suitable for the construction of a major masonry dam for the principal reason that to attain a reasonable wall height and make use of the sandstone for abutments it would be necessary to found the structure upon a mass of shales which, although essentially sandy, embrace clayey layers liable to induce slippage when lubricated by percolating waters. Moreover, the thickness of shales beneath the cliffs does not impress from the viewpoint of strength to resist abnormal pressures. The sandstones and associated conglomerates would form suitable locks for the abutments. Although the bedding planes are open on exposed surfaces it can be expected that adequate closure would be present when followed into the gorge sides. Pressure grouting should be effective in sealing the joints and planes to prevent leakage round the abutments.

Finally, this site was examined by Mr. L. F. Harper in 1931. He reported adversely (Papers Misc. 31/18921 herewith).

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GENERAL CONCLUSIONS.

Of the six sites examined, four are not recommended for reasons involving unsuitable structural and/or lithological conditions. These examples are :- The Needles, Nos. 2, 3 and 4 of the Cranky Rock group.

No. 1 site of the Cranky Rock area is selected as first preference from the geological viewpoint for either a masonry or an earthworks dam. Some doubt must remain as to the suitability of No. 5 Site for a masonry structure but no serious objections to it for an earthworks wall are forthcoming.

This report conveys the impressions of a generalreconnaissance examination designed to assist in the ultimate selection of one site for the project and it is considered that if the matter is proceeded with more detailed investigations with respect to Nos. 1 and 5 Sites, Cranky Rock are essential. It is recommended that such geological surveys be undertaken, if, and when, the Water Conservation and Irrigation Commission signify desire for same.

Senior Geological Surveyor.
12. 3. 1941.

The Government Geologist.

46/2411 M.

Dr. 3. Dam Site"

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Cranky Rock Dam Site - Belubula River, near Canowindra.

I visited Cranky Rock Dam Site with Mr. Broughton, Assistant Engineer, on 21st March. The area is the subject of a preliminary report by Mr. E. J. Kenny, Geological Surveyor, in 1941, and the site now being tested is No. 5 in Mr. Kenny's report.

The rocks on the proposed centre line consist of fine-grained tuffs with beds of coarser felspathic tuffs and cherty shales. Fragments of chert are of frequent occurrence within some tuff beds, and in certain beds fine joints occur, filled with calcite. The series strike N.15°W to N.20°W and dip south westerly at angles of 25 to 40 degrees, the higher dips occurring near the top of the left abutment. The tuffs outcrop as narrow beds of hard-jointed rock with areas devoid of outcrop between them. Shallow holes in the latter show that they are underlain by somewhat felspathic tuffs, highly weathered and containing numerous fine cracks breaking the mass into small cubes.

About 80 feet east of the proposed centre line and 20 feet from the river bank, a small fault occurs. It consists of two narrow fissures partly filled with quartz lenses and a block of solid rock about 4 feet wide between them. The block has fallen about 6 inches at the outcrop. This fault is a minor one and may not extend as far as the centre line. It may provide a locus of leakage but can be adequately dealt with by removal of any weathered or broken rock and the fissures should be amenable to grouting.

Seven boreholes have been sunk along the centre line on the left bank with a shot drill. The rock breaks easily along the bedding planes and owing to variation in degree of decomposition in various beds and numerous fine joint planes, cores are not very satisfactory from some of the holes, from the point of view of determining solid rock foundation.

It was observed that the degree of weathering is greater towards the higher ground, while fairly hard rock outcrops for approximately 80 feet above the river bed. The latter is very jointed but drill holes Nos. 3, 4, 5 and 6 indicate that the heavily jointed and broken material may extend about 15 feet from the surface. In the weathered zones, boreholes have been sunk to depths of 70 feet or more without obtaining satisfactory cores. In my opinion this does not necessarily mean that weathering extends to this depth, but two more bore holes, 2A and 3A between No. 1 and No. 2, and No. 2 and No. 3 bores, are suggested for verification purposes.

The deepest bores, Nos. 1 and 2, are situated near the top of the left abutment, and in the case of an earth fill wall will be required to carry very little weight and may be found to be relatively impermeable to water under low head. There may be some initial leakage through the interstices of the partly weathered rock, but this would be expected to be impeded by the surface soil of the reservoir side close to the dam, once the soil became saturated, and some of the clay and silt was carried into the cracks. This opinion is the result of examination of shallow holes sunk during the erection of the boring plant and may be altered when deeper ground can be examined either in bore cores or in a trial shaft, if the latter proves necessary.

In the area of solid rock outcrop between bore No. 6 and the river, it is considered that about 15 feet of the surface will have to be removed before a reasonable foundation will be exposed but that jointing in the latter can be closed by pressure grouting.

The accompanying plan and section illustrates the geological conditions as far as can be interpreted by outcrops and boreholes

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and the approximate position of a suitable rock foundation is indicated. This may be modified when extra bores are sunk. No information other than that of a general nature can be supplied concerning the right bank at present, but about six boreholes, 100 feet apart, should provide the necessary information.

An attempt has been made on the section to indicate the base of the alluvium on the right bank based on the behaviour of the river and the contour of the slopes adjoining it. If this section is approximately correct, the alluvium may be 50 feet deep at its deepest part. The underlying rock may be weathered below for a short distance. It is considered that three bores should be sunk beneath the alluvium to hard rock.

Geological Surveyor.
26. 5. 46.

The Government Geologist.

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31/18921 M.

Water Conservation and Irrigation Commissio
Examination of suggested dam site, Belubula River.

by
L. F. Harper

A geological examination has been made of a dam site on the Belubula River in company with Mr. Huddleston, Investigating Engineer, and Mr. Broughton, Surveyor, both of the Water Conservation and Irrigation Commission, and the following information is supplied.

The site examined is known as The Needles, and is in the Parishes of Malongulli and Carlton, County Bathurst.

The Belubula River has here cut a comparatively narrow gorge through beds of hard fine-grained quartzite interbedded with relatively soft shales. Down stream from the suggested site, a bed of massive conglomerate occurs also interbedded with soft strata.

These beds have a westerly dip, that is, down stream, at an angle of about 20 deg. from the horizon, and a slight pitch from both the north and south in towards the river.

A few chains above the site the quartzite beds lie practically horizontally for a short distance, or dip slightly in the opposite direction, when they again resume the dip mentioned above.

The general dip changes abruptly, and a noticeable line of weakness, with a slight fracturing, as evidenced by depressions in the land surface and rock faces, was observed. The possibility of a north and south geological fault occurring at this position suggests itself, and is emphasised on the southern side of the river in the direction of the strike of the suggested fault, by the abrupt termination of the escarpment formed by soft rocks underlying the hard quartzite horizon.

If this should be a fault, however, the occurrence is some chains above the site at present being considered, and would probably not affect dam construction thereon, but is referred to in case a site further up stream is considered.

The quartzite has pronounced bedding planes, and close stratification predominates. The former are quite unsealed with the result that open spaces extend along the bedding planes for many feet beyond the exposedrock faces.

These planes will not be actually open in strata not exposed to atmospheric conditions, but, nevertheless, they will be present, and offer no resistance to upward or downward pressure. Jointing at right angles to the bedding is also very noticeable, and this, in conjunction with the unsealed bedding planes, would greatly facilitate disintegration under abnormal stresses. However, intensive cement grouting under pressure might overcome the-

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disadvantages.

Two other important factors call for comment from an engineering point of view.

(1) Owing to the relatively low dip of the strata and the necessary bearing of the centre line of a dam, construction would be distributed over a strong rock type (quartzite) on both sides, whilst the central portion of the structure would have its foundation in the softer underlying strata.

(2) With strata dipping down stream, and relatively soft rock types occurring both above and below the rock in which a large portion of the foundations would be situated, the risk of sliding would be more pronounced.

Reviewing all the geological conditions observed, I am of the opinion that the existing structures and variation in rock types are not favourable for the erection of a major dam.

Submitted for approval to forward the attached copy of above report to the Water Conservation and Irrigation Commission.

Senior Geological Surveyor
29.10.1931.

The Under Secretary.

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DIAGRAM B

"THE NEEDLES", BELUBULA RIVER.

SECTION LOOKING NORTH

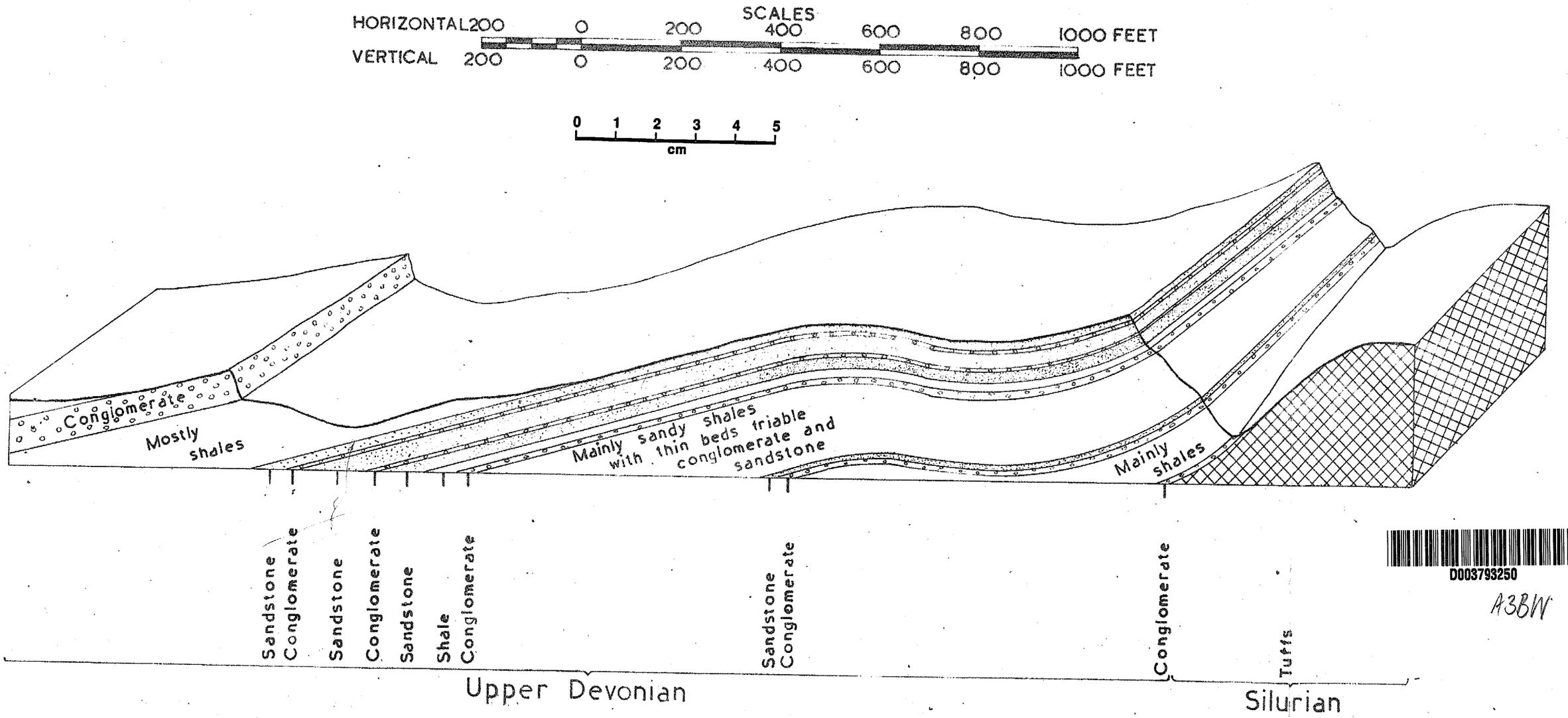

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DIAGRAM A.

0 1 2 3 4 5
cm

CRANKY ROCK DAM SITES

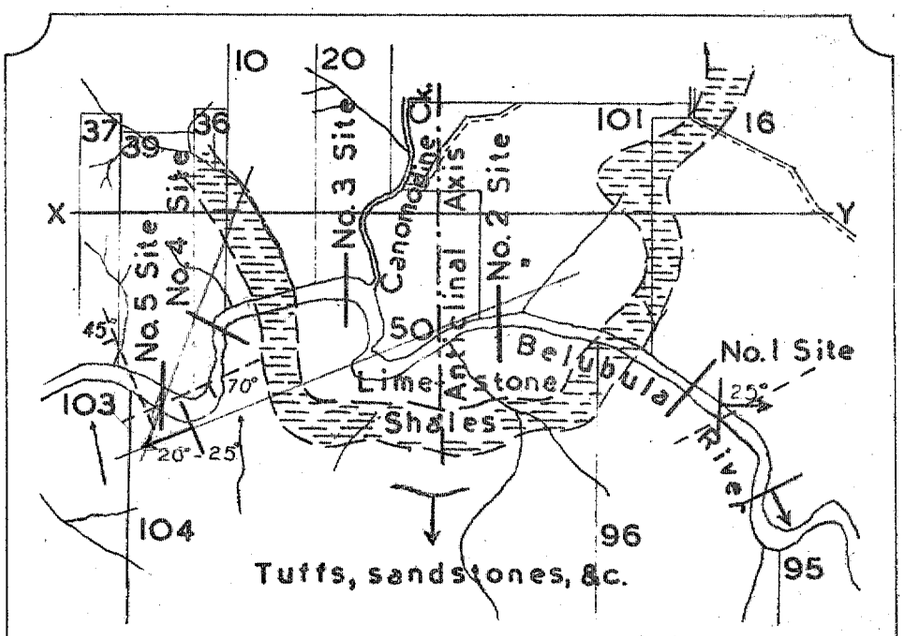
BELUBULA RIVER

SCALE HORIZONTAL 40 20 0 40 80 CHAINS

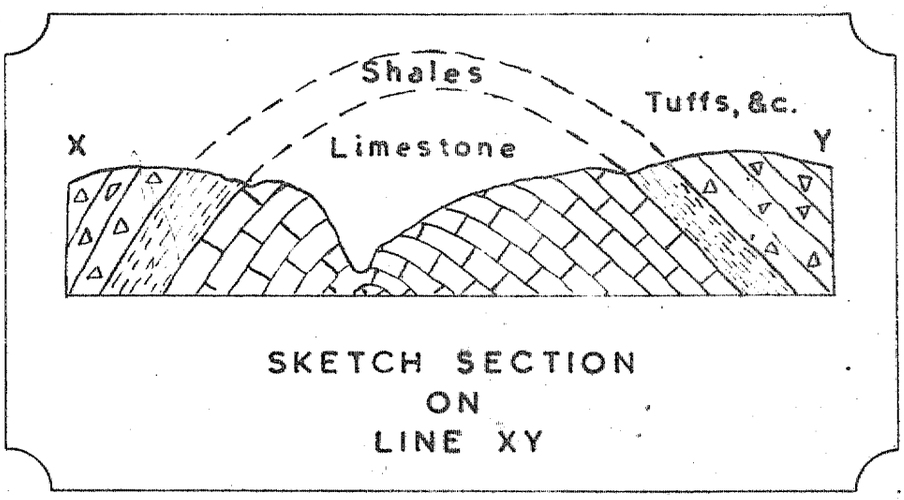
Note: Geological boundaries approximate. Sketch only. Alluvium omitted.

Strike & dip of beds shown thus: 70°

Strike & dip of joints shown thus: 70°



PLAN.



SKETCH SECTION
ON
LINE XY

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