TR12-59-68

14. GEOLOGICAL REPORT ON DAM SITES, WHITEWATER CREEK, KINGSTON

by W. R. Moore

INTRODUCTION

The study of the feasibility of two dam sites on Whitewater Creek in the Kingston district has been undertaken by the Department of Mines at the request of the Metropolitan Water Board. This report covers the initial geological studies and does not include preliminary geophysical surveys as these are still in progress.

It is proposed to construct a storage on Whitewater Creek consisting of either a single dam 120 feet high or two dams each about 80 feet high. The lower dam site is approximately one mile W of Kingston and half a mile N of the Channel Highway, whilst the other site is approximately three-quarters of a mile upstream from this.

Detailed surface geological mapping has been completed at the two sites and in the catchment area of Whitewater Creek and its main tributary, Boddys Creek (figs. 37 & 16). The geology of the area N of the Leslie Vale Road and E of the Channel Highway has been compiled from previous work incorporated in the geological map of Hobart, 1966.

PREVIOUS LITERATURE

McDougall (1962) mapped the W portion of the area covered by this report in his study of the dolerite at Red Hill. Paxton (1964) mapped the Kingston area including Whitewater and Boddys Creeks. Macleod (1962) previously investigated and reported on the lower dam site.

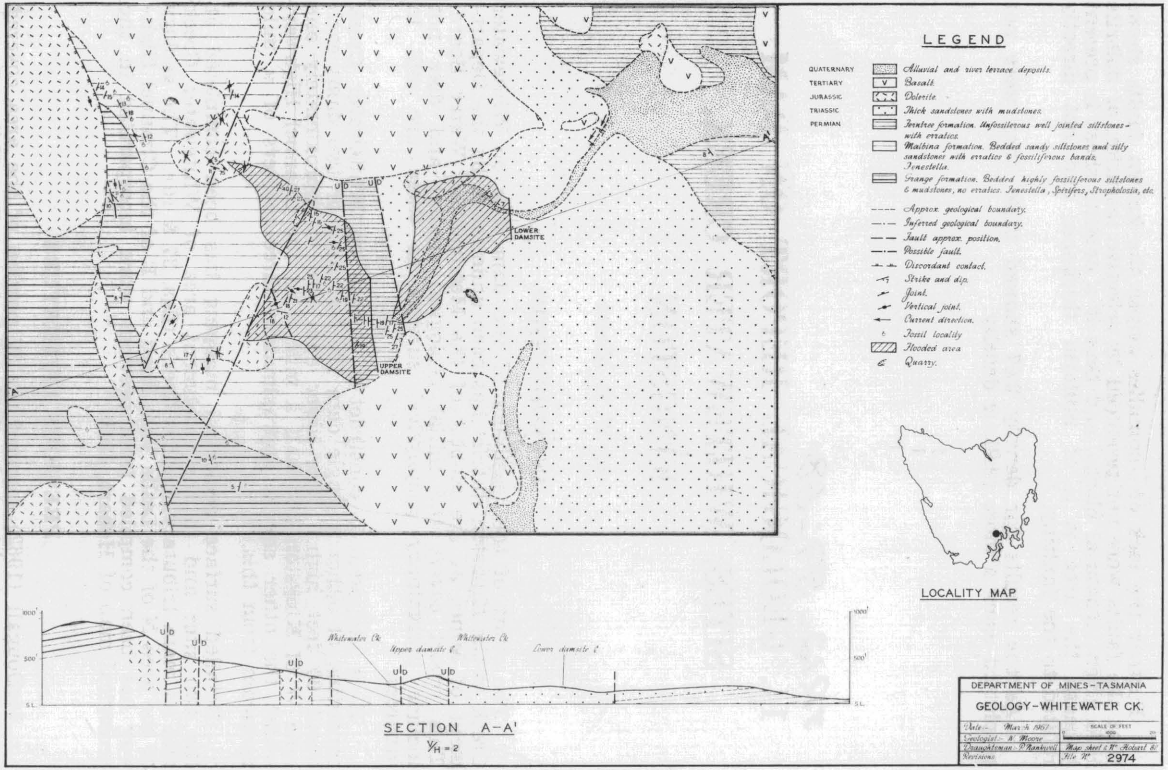
LEGEND
QUATERNARY
Alluvial and river terrace deposits.
TERTIARY
Basalt.
JURASSIC
Dolerite.
TRIASSIC
Thick sandstones with mudstones.
PERMIAN
Ferntree formation. Unfossilerous well jointed siltstones - with erratics.
Malbina formation. Bedded sandy siltstones and silty sandstones with erratics & fossiliferous bands. Fenestella.
Grange formation. Bedded highly fossiliferous siltstones & mudstones, no erratics. Fenestella, Spirifers, Stropholosia, etc.
Approx. geological boundary.
Inferred geological boundary.
Fault approx. position.
Possible fault.
Discordant contact.
Strike and dip.
Joint.
Vertical joint.
Current direction.
Fossil locality
Flooded area
Quarry.
LOWER DAMSITE
UPPER DAMSITE
LOCALITY MAP
Whitewater Ck
Upper damsite ℄
Whitewater Ck
Lower damsite ℄
SECTION A–A'
V/H = 2
DEPARTMENT OF MINES–TASMANIA
GEOLOGY–WHITEWATER CK.
Date:- March 1967
Geologist:- W. Moore
Draughtsman:- P. Hankwell
Revisions
SCALE OF FEET
Map sheet & No. Hobart 81
File No. 2974

FIGURE 16

STRATIGRAPHY

The rocks in this area have been subdivided in the following manner:—

	Map symbol
Sedimentary Rocks—	
Quaternary—Sediments	Qr
Triassic—Knocklofty Formation	T_R
Permian—	
Grange Mudstone	P_g
Malbina Formation	P_m
Ferntree Formation	P_f
Igneous Rocks—	
Jurassic—Dolerite	J_{dl}
Tertiary—Basalt	T_b

Permian

The oldest rocks present in the area mapped are Permian sediments which outcrop at the upper dam site and W from there to the high plateau of the Leslie Vale-Longley region. These rocks have been subdivided into three units which are tentatively correlated with the stratigraphic subdivision of the Permian system for the Hobart district as set out by Banks and Hale (1957) and Banks and Read (1962).

GRANGE MUDSTONE

The Grange Mudstone in the valley of Whitewater and Boddys Creeks consists of highly fossiliferous mudstone which weathers to a white colour, interbedded with some siltstone beds. It is often sandy and occasionally contains thin bands of grit at the base. The best exposed sections of the Grange Mudstone are along the H.E.C. maintenance track on Parks Hill and in a W tributary of Boddys Creek. The exposed thickness of the section of Parks Hill is about 300 feet but this may be faulted. In the tributary of Boddys Creek the Grange Mudstone is exposed over a thickness of 200 feet but it is terminated above by dolerite intrusion (fig. 17). Lithologically the Grange Mudstone resembles the fossiliferous mudstone horizons in the overlying Malbina Formation. Fossils found in the Grange Formation include *Spiriferina, Strophalosia* and fenestellids.

MALBINA FORMATION

The Malbina Formation in Whitewater and Boddys Creeks consists of coarsely bedded, well-jointed, hard, sandy siltstone and silty sandstone with erratics and fossiliferous mudstone bands at the top and at the base. Again the sections exposed in these creeks are considered to be faulted. The fossiliferous units contain mainly fenestellids and *Spirifer* but no *Strophalosia* was found. Fossils are also present in both the siltstone and sandstone but are scarce. Worm trails and grit bands occur at the base of the sandstone units. The best exposed section of the Malbina Formation is in Whitewater Creek but even there the section is incomplete as both the top and bottom have been faulted out. Except for the mudstone bands the top 300 feet of the Whitewater Creek section appears to correlate approximately with the Malbina Formation of Banks and Read (1962).

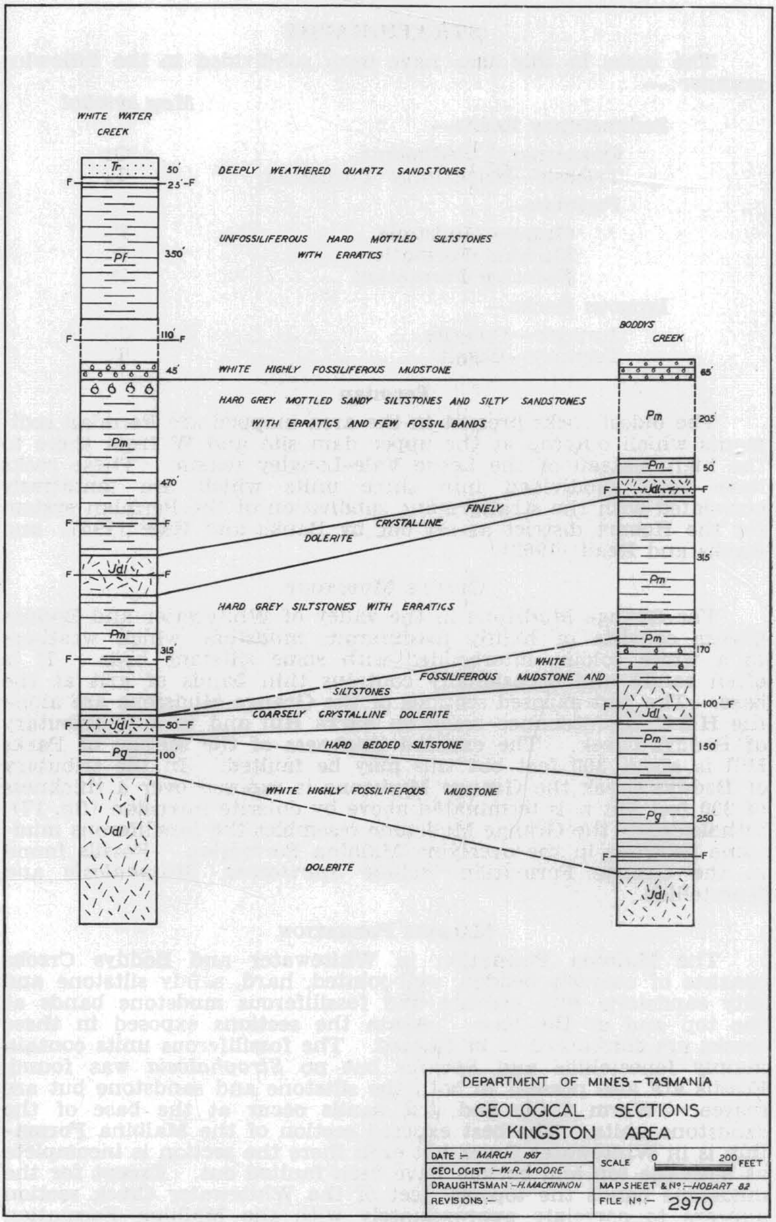

FIGURE 17

5 cm

The Malbina Formation covers the largest part of the proposed reservoir area for the upper dam site and is faulted against a block of Ferntree Group sediments. The stratigraphic position of the beds referred to as the 'Malbina Formation' in Whitewater and Boddys Creeks is still somewhat uncertain and it is therefore difficult to estimate the amount of movement on the fault immediately upstream from the upper dam site. McDougall (1962) and Paxton (1964) mapped these beds as lower Permian whilst Leaman (pers. comm.) has suggested that the mudstone horizon exposed in the creeks upstream from the upper dam site belongs to the Grange Mudstone and the underlying beds to the Faulkner Group. Such a succession requires a duplication of the sequences in the headwaters of Boddys and Whitewater Creeks and would infer additional faulting in the area for which surface evidence is lacking. The writer's reasons for considering this sandstone-siltstone sequence as belonging to the Malbina Formation are set out below:—

(1) The 'curly bedding' produces a mottled texture in the sediments and this is generally present in the Malbina and Ferntree Formations.

(2) The presence of large numbers of erratics.

(3) The lithological similarity of the Malbina sediments as indicated on Parks Hill to the sediments in Whitewater and Boddys Creeks.

FERNTREE FORMATION

Rocks assigned to the Ferntree Formation occupy the long narrow N-S trending spur E of Boddys Creek and N of Doctors Hill where they are overlain to the N and S by basalt. Boulders of rocks of the Ferntree Group cover much of this spur and a small exposure 4 to 6 feet high has been observed on the S face of the small gorge cut through this spur by Whitewater Creek. In the creek bed itself there is a poorly exposed section of the Ferntree Group some 350 feet thick. This is bounded to the E and W by faults.

The rocks of the Ferntree Group consist of hard unfossiliferous siltstone, with beds 3 to 4 feet thick characteristically intersected by a strong vertical joint pattern. In the vicinity of the dam site the beds dip at angles between 19° and 27°. The siltstone is often sandy with characteristic 'curly' bedding and contains rock fragments. A clay layer one inch thick has been observed at the dam site and the siltstone bed overlying it appears to have slipped and tilted producing an apparent steep dip of 27°.

Triassic Sediments

KNOCKLOFTY FORMATION

Triassic sandstone and mudstone cover the E section of the valley of Whitewater Creek and are the main rocks present at the lower dam site and in its proposed reservoir area. Apart from the sandstone which forms well-marked cliffs, the outcrop in the areas of Triassic sediments is very poor. The only exposures of Triassic mudstone observed are in the old clay pits where mudstone intercalated with minor thin micaceous sandstone and shale is present. Exposures of weathered Triassic sandstone and mudstone were also noted in the trench for the new water main from Kingston to Howden.

The sandstone exposed at the lower dam site is massive, well-sorted and coarsely cross-bedded with iron nodules and widely spaced vertical joints. It is medium to fine grained and composed mainly of quartz with minor amounts of feldspar and mica. The sandstone is porous and permeable especially along the bedding and vertical joints, and would appear to form a good aquifer.

The Triassic sediments in this district are considered to be correlates of the Knocklofty Formation of the Hobart district, probably close to the base of this formation.

Quaternary Sediments

Recent sediments in the dam site areas include widespread talus deposits especially on the low interfluves between Whitewater and Boddys Creeks, and at the upper dam site. River alluvium of sand and silt with some gravel is extensively developed in the lower part of the valley of Whitewater Creek between the two dam sites. This material exceeds seven feet in thickness in places. Quaternary clay derived from the weathering of Triassic mudstone is quarried E of the upper dam site. No extensive area of clay derived from the weathering of Jurassic dolerite has been observed.

IGNEOUS ROCKS

Jurassic Dolerite

Dolerite outcrops in the reservoir areas of both dams, but the surface exposures are not sufficient to determine the shape of the intrusions. The only contact exposed is a discordant one of dolerite against crushed Permian sediments on the track to Parks Hill and on the track crossing the upper reaches of Boddys Creek.

Dolerite boulders may be traced between Whitewater and Boddys Creeks connecting the two dolerite intrusions and it seems likely that this intrusion is continuous between the creeks. If this is so it is probable that the dolerite intruded along a fault. This is supported by a change in the direction of dip of the bedding from E to W in the sediments adjacent to some of the minor intrusions (Cross section A-A).

Dolerite boulders have also been traced from the dolerite outcrops NE of the lower dam site along the E bank of Whitewater Creek to the upper dam site. This boulder train could possibly represent another dolerite intrusion along a NE-SW fault, which is now followed by Whitewater Creek.

The dolerite varies in texture from a very coarsely crystalline rock similar to the granodiorite of Red Hill, to a fine crystalline almost basalt texture within the same intrusion and between the intrusions.

Tertiary Basalt

Three areas of basalt occur in Whitewater Creek. They are found:—

(1) N of Parks Hill where a small isolated outcrop occurs in close association with dolerite.

(2) N of Whitewater Creek where the largest outcrop occurs and from the topography appears to be part of a flow originating in the Summerleas Farm area and spreading out at lower levels above the proposed dam sites. It is probably no more than thirty-to forty feet thick at Summerleas Farm but is much thinner in the lower levels.

(3) At Doctors Hill where there is a thickness of ten feet exposed in a road cutting at the summit of the hill. Outcrops of this basalt occur close to baked siltstone near the upper dam site. Small boulders of red tuff have been found near the siltstone-basalt contact but no outcrops of this material have been located.

Basalt outcrops are poor throughout the area and the boundary on the map has been established on such evidence as the presence of basalt boulders and the distribution of red soil. The basalt contains olivine phenocrysts, often very large. It is frequently coarsely vesicular and weathers rapidly to a fine rubble.

STRUCTURE

The Whitewater Creek area consists of a series of stepped, tilted blocks with uplift occurring along a series of N-S and NNE-SSW faults towards the W in the direction of the plateau formed by Parks Hill-Leslie Vale (Cross section A-A[1]).

The uplifts occurred penecontemporaneously with the dolerite intrusions along the discordant contact exposed on the E margin of the plateau. Two sets of small dolerite intrusions are thought to be associated with the uplift. It seems possible that a NNE-SSW fault is present between the two dam sites and is associated with dolerite in intrusions at the lower dam site. Between the two sites Whitewater Creek may occupy this fault zone.

The two faults that border the spur near the upper dam site are not exposed in Whitewater Creek. Where the fault upstream from the dam would be expected in the creek bed there is a gap in the outcrop some 250 feet wide between the Malbina Formation and the Ferntree Formation. Downstream from the dam site there is a gap of some 70 feet with no outcrop between the Ferntree Formation and the Triassic sandstone. The position and direction of these faults is not known although their approximate trend has been inferred from the topography, the distribution of siltstone talus, and the sandy soil derived from the Triassic sandstone (fig. 16).

The two faults downthrow several hundred feet to the E and appear to be associated with the downwarped structure of North West Bay. MacLeod (1962, pp. 59) estimated the throw of the upstream fault to be 600 feet, from the juxtaposition of basal Triassic conglomerate overlying Permian siltstone E of Boddys Creek. This conglomerate, however, was not located during the present survey although a search was made for it. If the sediments W of the Ferntree Group outcrop are Lower Permian in age and not the Malbina Formation, the throw on the upstream fault would be more than 1,000 feet with the Ferntree Group, Malbina Formation and Grange Mudstone missing. The throw of the downstream fault is not known from the evidence available but appears to be comparable in size with the fault upstream from the Risdon Brook dam (Jennings, 1965).

THE DAM SITES

The Lower Dam Site

This site is situated in a wide shallow gorge with well developed cliffs on the N bank extending upstream and downstream for a distance of 500 feet. On the S bank outcrops of Triassic sandstone form discontinuous low ledges 5 to 9 feet high over a similar distance. The reservoir area is a shallow wide valley which narrows upstream to a gorge forming the site for the upper dam. Outcrop above the lower dam site is poor and the reservoir area is thought to be underlain mainly by Triassic sandstone except in the NW where large dolerite boulders at the surface and a few poor outcrops indicate the presence of dolerite.

The Triassic sandstone appears to be porous, strongly jointed and deeply weathered above river level. For these reasons leakage could be anticipated around the abutments and under a dam built on this site.

As most of the reservoir area is also underlain by Triassic rocks, leakage from the reservoir could also be high and may occur in a N and S direction as well as downstream under the dam.

The difference in height between the sandstone cliffs on the N bank of the dam site and the small sandstone benches on the S bank suggests that a small E-W fault could be present in the bed of the river and form another leakage path under the dam.

At the present time then, although no specific investigations have been made into the permeability of the foundations of the lower dam, the general geological background indicates that it is unlikely to be a satisfactory site.

The Upper Dam Site

This is situated in a narrow gorge about 100 feet deep which has been cut by Whitewater Creek as it crosses a faulted and tilted block of Permian rock. This block of hard siltstone forms a prominent N to S trending spur around which Whitewater Creek flows in a wide U bend. Basalt outcrops N and S of this spur at a higher level. The reservoir area is underlain by sandy siltstone and silty sandstone interbedded with narrow fossiliferous mudstone bands. Three small, poor exposures of dolerite within the reservoir area appear to indicate isolated dolerite intrusions.

Where unweathered sediments occur at the dam site it is anticipated that both the porosity and permeability of the rocks will be low and that leakage will be confined to bedding planes and joints. At present there is no reason to believe that the overall permeability will be any higher than that at Risdon Brook.

The fault upstream from the dam site brings soft mudstone against siltstone and MacLeod (1962) anticipated that this fault would be sealed by an impermeable clay plug. Even if this were so, a good deal of shattering is still likely to be present within the siltstone and the fault must still be considered as a potential leakage path.

If the height of the dam is raised sufficiently to submerge the basalt lying to the N and S of it, the sub-basaltic tuff and sediment could provide an additional leakage path.

A clay band one inch thick has been observed along a bedding plane in Ferntree Formation at the dam site. This, combined with the high dip of the strata suggests the possibility of slippage along the bedding planes in a similar manner to that suggested for Risdon Brook dam (Jennings, 1965).

MATERIALS OF CONSTRUCTION

At present it is anticipated that both the proposed dams would would be rock fill. The most suitable materials in the area for this purpose are either dolerite or basalt. Of these, the dolerite would be more satisfactory on account of its uniformity and higher density.

Dolerite occurs near the upper dam site and an adequate thickness for quarrying is thought to be present within an economic transporting distance.

Basalt outcrops are found close to both sites, to the N and S, but only on Doctors Hill and near Summerleas Farm in any thickness. The basalt at Doctors Hill contains frequent vesicular bands and large phenocrysts of olivine which weather rapidly. The basalt at Summerleas Farm is more compact but highly jointed.

The clay derived from weathered dolerite has been used elsewhere in Tasmania for the core of rock fill dams, however, no thick deposit of such material has been observed during geological mapping in this area. Clay derived from the weathering of Triassic mudstone is also present but the suitability of this material for the clay core of a dam has not been established.

CONCLUSIONS

Of the two proposed dam sites in Whitewater Creek the upper site is geologically more attractive.

The Lower Dam Site

This dam site is situated on a porous and permeable foundation and much of the reservoir is thought to be underlain by similar material. A potential leakage path may exist along the N-S fault between the Permian siltstone and Triassic sandstone. The present mapping confirms and enhances MacLeod's (1962) opinion on the unsuitability of this site. At present no drilling or further investigation is recommended for the site.

The Upper Dam Site

At this site there are two major faults bordering the proposed dam. The dam would be built on Permian sediments of the Ferntree Formation with steeply dipping beds and basalt-siltstone contacts close to the proposed top water level.

Although geological problems are present they do not appear at this time to be more severe than those encountered at Risdon Brook. Therefore a more detailed investigation of this site should be carried out.

RECOMMENDATIONS

The following recommendations apply to the upper of the two dam sites proposed on Whitewater Creek.

(1) Sub-surface rock conditions should be examined by means of diamond drilling and the following preliminary drilling programme is recommended—

(*a*) Four holes along the centre line of the dam to a depth of about 100 feet.

(*b*) Two vertical holes in the abutments to a depth of at least 100 feet.

(*c*) Two angle holes to a depth of at least 50 feet into the floor of the valley.

(*d*) Two angle holes drilled through each of the faults upstream and downstream.

(*e*) One hole drilled through the basalt into the underlying siltstone above the centre line of the dam to the S.

All these drill holes should be pressure tested at ten feet intervals and every endeavour should be made to obtain NX cores.

(2) If the results of this preliminary programme prove to be satisfactory additional drilling for design purposes should be allowed for, together with sluicing and clearing the site to bedrock in order to make detailed surface geological examinations. Additional drilling to test the permeability in the reservoir area may be required at this stage.

(3) Geological investigations followed by drilling and perhaps geophysical tests should be undertaken to locate a suitable quarry site for the production of rock fill.

(4) An accurate contour map of the reservoir area W of the upper dam site should be constructed.

(5) The present regional geological map should be extended into the Browns River area to the N and towards North West Bay to the S in order to locate the two faults that border the upper dam site.

(6) A stratigraphic and palaeontological study should be made to establish the stratigraphic position of the Permian sediments which lie upstream from the upper dam site in the Whitewater Creek area.

References

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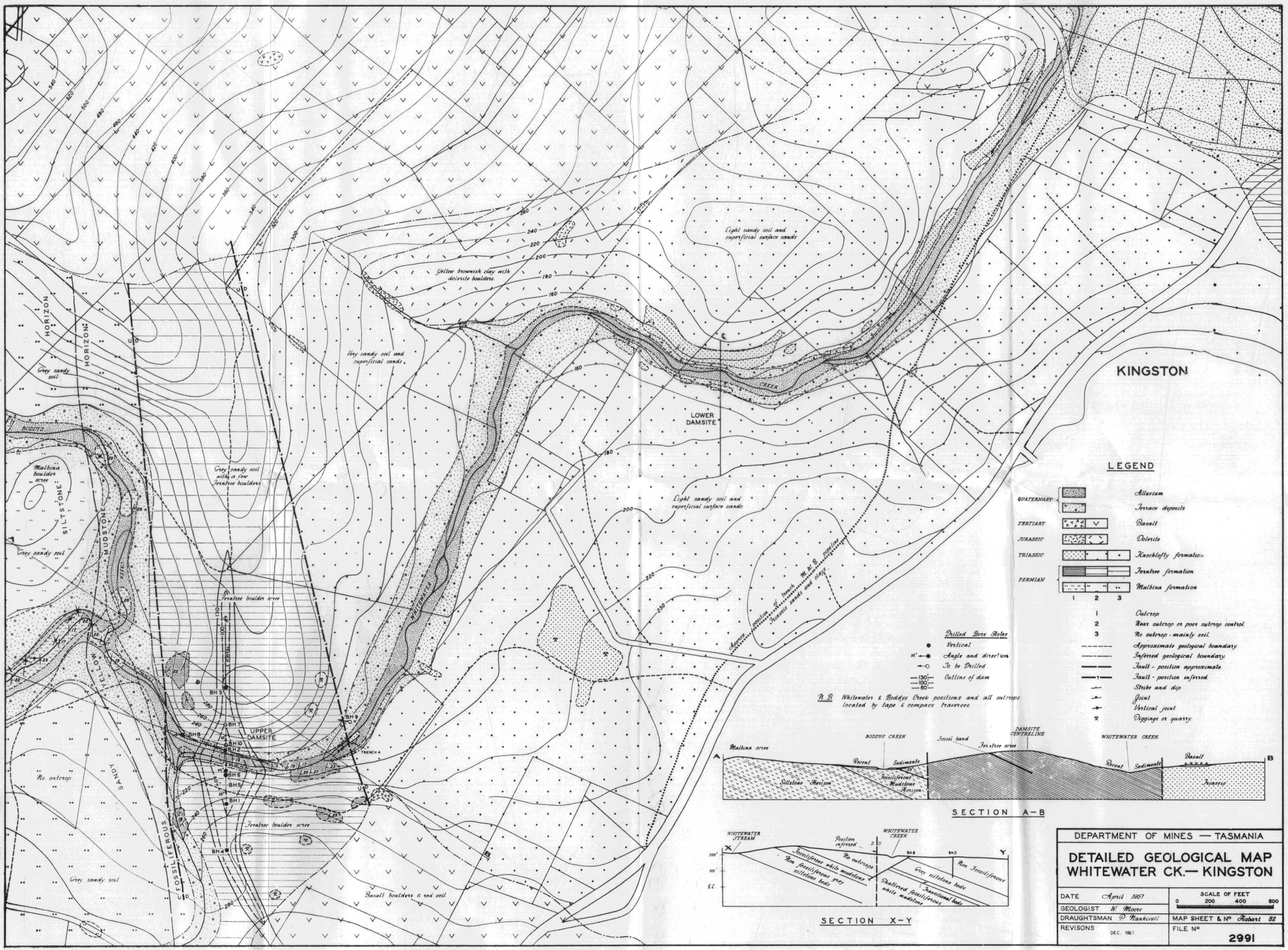

DEPARTMENT OF MINES — TASMANIA
DETAILED GEOLOGICAL MAP
WHITEWATER CK.— KINGSTON
DATE April 1967
GEOLOGIST W. Moore
DRAUGHTSMAN P. Nankivell
REVISONS DEC. 1967
SCALE OF FEET
0 200 400 600
MAP SHEET & No Hobart 82
FILE No 2991
LEGEND
QUATERNARY
Alluvium
Terrace deposits
TERTIARY
Basalt
JURASSIC
Dolerite
TRIASSIC
Knocklofty formation
Ferntree formation
PERMIAN
Malbina formation
1 2 3
1 Outcrop
2 Near outcrop or poor outcrop control.
3 No outcrop - mainly soil.
Approximate geological boundary
Inferred geological boundary
Fault - position approximate
Fault - position inferred
Strike and dip
Joint
Vertical joint
Diggings or quarry
Drilled Bore Holes
Vertical
Angle and direction
To be Drilled
Outline of dam
N.B. Whitewater & Boddys Creek positions and all outcrops located by tape & compass traverses
SECTION A-B
SECTION X-Y
KINGSTON
LOWER DAMSITE
UPPER DAMSITE
BODDYS CREEK
WHITEWATER CREEK
DAMSITE CENTRELINE
Malbina scree
Recent
Sediments
Fossil band
Ferntree scree
Basalt
Siltstone Horizon
Fossiliferous Mudstone Horizon
Triassic
WHITEWATER STREAM
Position inferred
No outcrop
Fossiliferous white mudstone
Non fossiliferous grey siltstone beds
Shattered fossiliferous white mudstone
Grey siltstone beds
Transitional beds
Non fossiliferous
Light sandy soil and superficial surface sands
Yellow brownish clay with dolerite boulders
Very sandy soil and superficial sands
Grey sandy soil
Grey sandy soil with a few Ferntree boulders
Malbina boulder scree
Ferntree boulder scree
Basalt boulders & red soil
No outcrop
FOSSILIFEROUS
YELLOW
MUDSTONE
SILTSTONE
HORIZON
SANDY
WHITEWATER
Approx. position of trench M.W.B. pipeline
Triassic sands and clays
TRENCH 4
BH1
BH2
BH3
BH4
BH5
BH6
BH7
BH8
BH9
BH10

FIGURE 37