

23rd December, 1938

MEMORANDUM:Examination of Hydro-Electric Works, Tarraleah

We desire to report that we have together made brief inspections of certain geological features which may be of importance in relation to the operations connected with construction and maintenance of the Hydro-Electric works at Tarraleah.

After careful consideration and discussion of our observations we believe that the following facts can be established with reasonable certainty.

(1) The proposed site for the dam across the Derwent River at Butler's Gorge is as nearly ideal as is possible to conceive.

(2) We have examined the outcrops on both sides of the river as fully as the time at our disposal would permit and are satisfied that the diabase is massive and solid and that there are no major structural weaknesses present which can adversely affect the stability of the dam.

(3) The diabase is, as always, considerably jointed at the surface, but not more than is normal in massive igneous rocks generally.

Naturally, the most intensely jointed portions will be removed in excavating the foundations for the dam.

It must be expected that jointing will persist to depths of scores of feet, in fact, to any depth which can be visualised as capable of being attained economically in the excavation of foundations. Such widely spaced narrow joint fissures in no way condemn the rock foundations for even the most exacting conditions. The rock masses are so effectively bound together that they may be regarded as massive. Such jointing does not present the objectionable features of gneissic structure, schistosity, shearing or stratification.

(4) Nowhere within the sector suggested as the site for the dam is there any trace in the outcrops of very closely set jointing likely to introduce an element of weakness.

We have observed zones of such closely spaced joints in several places in the district, e.g. on the left bank of the Derwent 200 or 300 yards down-stream from the dam-site, in the quarry near the intake and in the cut above the power house. We believe that no such flaw exists at the dam site.

(5) While we have not had time to examine exhaustively the whole of the cores produced by diamond drilling we have examined carefully those which are known to the Constructional Engineer to exhibit any abnormalities of even a minor nature.

(6) A general characteristic of all the cores is that at moderate depths all joint fissures appear to be filled with calcite. This more or less effectively seals the cracks and almost or entirely prevents circulation of water through them. This feature suggests that the formation as a whole, is satisfactorily impervious.

Mostly the calcite veins are only a small fraction of an inch in width. The largest encountered in drilling appears to be some four inches in width.

(7) In the cores of No.9 and No.12 bores, it was pointed out to us that narrow lines of oxidation were encountered in drilling at depths approximately to 70 feet. We understand that drilling circulation was lost when these open cracks were encountered, but recovered a little deeper.

We interpret this phenomenon as being due to local solution of the calcite filling of a joint plane by descending meteoric water. It is practically certain that such an effect will never extend below river level. A few such cracks must be anticipated. They may cause extremely small and insignificant seepages unless closed by natural silting or by grouting. No serious trouble from this cause need be anticipated.

(8) We have indicated to the Resident Engineer the points on the banks which we consider offer the most favourable purely geological conditions for dam foundations. As a result of our inspection of the west bank on 17th December we are inclined to advise that the wall be built a little higher upstream than the point suggested by us to Messrs. Nicholl and Rowntree on the 16th. We consider that the final selection should be made so as to place the most massive and continuous submerged rock bar just down-stream from the toe of the wall.

(9) We consider that it is unnecessary greatly to multiply the number of diamond drill holes sunk. Such as are drilled should be selected so as effectively to insure solidity of the foundations of the dam itself.

(10) We desire to point out that no reasonable amount of drilling can completely eliminate the bare possibility of existence of a joint fissure larger and more open than the rest. Bores might be sunk within a few feet of one another on opposite sides of such a crack without encountering it. As stated above, however, we consider that the misfortune of discovering anything of the nature of a serious flaw is so remote as to be beyond the normal range of probabilities.

(11) We have examined carefully the geological features revealed in the cutting made to carry the pipe lines from the crest of the hill near "The Chalet" to the Power House on the bank of the Nive River, with a view to suggesting methods of reducing the risk of landslips which might endanger the pipe line or power house.

We are generally in agreement with the suggestions made by Mr. G. Fred Jakins in his report of 19th July, 1938.

(12) We find, however, that the nature of the geology is somewhat different from that suggested by him, and this introduces slight modification in the conclusions arrived at.

The whole of the rocks above the level of Anchor T consist not of diabase as indicated by him but of Tertiary basalts forming approximately horizontal lava flows. Our examination has not been sufficiently detailed to enable us to prepare a detailed geological section of these lava flows.

It appears, however, that each of the low cliff escarpments visible on the face of the hill is caused by a hard band in the basalt series. In the cutting, at such points, solid basalt outcrops.

(13) Between these solid outcrops the surface material is a mixture of basalt boulders and soil. There is a strong suggestion that minor landslips have played a part in producing the existing topography of the valley sides.

We consider that the presence of these "bars" of basalt makes for the general stability of the hill slope.

(14) Minor landslip movements of dimensions sufficient seriously to endanger the stability of the pipe line are not impossible and should be guarded against. Suggestions for effecting this are given below.

(15) The lower part of the hill, from Anchor T downwards consists of diabase, which, though massive, is considerably jointed at the surface. The characteristics of this formation are such as to suggest that major earth movement in the lower hill slopes is extremely unlikely. It is just conceivable that some quite improbable combination of structural factors may be present which could lead to such movement but no amount of investigations could attain certainty in such a matter.

(16) The overlying basalt rests on the denuded surface of the sub-jacent diabase at Anchor T, and, owing to the superior porosity of the basalts there is a notable amount of sub-surface water discharged at this point. The disturbance of equilibrium resulting from the construction of the cutting has led to some subsidence and slippage at this critical point.

To rectify this a traverse drain has been placed across the cutting at this point, and carried some distance beyond the northern wall of the cutting. While this has effected some improvement of the conditions we are of the opinion that precautions are required at this point.

(17) We suggest that the trench across the cutting be deepened to 20 feet and that a short tunnel be driven under the channel of the small gully there. This tunnel should be just long enough to drain effectively the slopes forming the head of this gully. Probably a length of 100 feet would suffice.

(18) If in the construction of the drain and tunnel suggested in (17) the surface of solid diabase is encountered at a depth less than 20 feet, the excavations need not be carried so deep as 20 feet.

(19) In the north wall of the cutting, just abreast of Anchor U there is a shear zone in the diabase within which are developed thin, nearly vertical, quartz veins. This forms a marked zone of weakness and gives rise to a considerable percolation of water.

We consider it desirable to drain this water away effectively to a depth of at least 5 feet below the bottom of the cutting, and suggest that this be done by means of a drain so graded at the bottom as to discharge under the pipe line and above (up-hill) from the foundations of Anchor U.

(20) We have examined the small landslips to the north of the pipe line opposite this point. While they are certainly due to slippage of a thin layer of soil on a super-saturated surface of subsoil, and while similar slips may recur we see no immediate reason for anticipating any major landslips at this point, and are unable to suggest effective remedial measures.

(21) Much more serious we consider the menace from the fall of individual boulders which are thickly scattered over the slope and partially embedded in the soil.

With the power house situated as it is at the foot of so steep a declivity, more or less funnel-shaped the possibility of serious damage by a falling boulder of even moderate dimensions must be admitted.

We do not believe that the danger depends on drainage factors nor that it can be minimised by artificial control of sub-surface drainage.

We would venture to suggest that though the method would not give immediate immunity, the close planting of the slope with trees such as pines would, in a short time afford a very real protection. Even if a falling boulder were not completely arrested by such aickett, its velocity would be so considerably checked as to reduce appreciably the extent of the damage it could do to the buidlings and their contents.

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