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ENGINEERING GEOLOGY OF THE PROPOSED CANBERRA LAKE

by

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Contents

	Page
Summary	1
Introduction	1
Leakage	1
Basement Rocks	2
Superficial Deposits	2
Lake Margins	3
Water Tables	4

Plate 1 ; Geological Map - Canberra City.

## SUMMARY

The storage area of the proposed Canberra Lake has been examined from the viewpoint of leakage, shoreline erosion and the effect of rising water tables.

The possibility of any significant leakage from the basin is restricted to one saddle on the perimeter of the storage, near Government House, where the distribution of alluvial terrace material is under investigation.

Shoreline erosion by waves will be minor; wave action will be most effective where banks are steeply shelving but in all cases these are rocky with thin soil cover; gently sloping shores are not vulnerable. Waves will increase turbidity particularly near the head of storage.

The rise in water tables consequent on the filling of the basin involves no immediate disability, although some service lines will lie below the water table and in two areas any future deep foundations will extend into the zone of saturation. The new Administrative Block is the only building whose foundations will extend below the new water-table but the building was designed for these conditions.

## INTRODUCTION

Engineering geology investigations on the proposed Canberra Lake, carried out for the Department of Works, Canberra, have covered the examination and drilling of alternative weir sites and a review of the siltation problem; the present report deals with the proposed storage area itself and discusses possible leakage from the basin, the nature of the margins in particular regard to erosion and the effect of the lake on water tables.

The basis of the work is the detailed geological and structural map of Canberra produced by A.A. Opik, 1953; this covers the whole of the basin and is reproduced on a scale of half a mile to one inch, with pertinent contours, as Plate 1 of this report. The writers have examined the margins of the proposed lake in the field. Although the site for the weir to impound the lake has not yet been determined, the maximum storage level has been fixed at the 1825 contour for all three weir sites, so that the examination of the storage related to the proposed weir site at Yarralumla which is farthest downstream covers the maximum area of lake. Over much of the storage, the 1825 contour has been marked by concrete or wooden survey pegs. The assistance of the survey section, Department of Interior, in determining the position of this contour in critical unmarked sections was greatly appreciated.

## LEAKAGE

The geology of the proposed storage consists essentially of folded and intruded Palaeozoic rocks with a sporadic thin cover of more recent and less consolidated deposits of river sand and gravel, lake sediments, dune sand and soil. For expediency, the possibilities of leakage from the storage is discussed under these two geological sub-divisions - the basement rocks and the superficial deposits.

### Basement Rocks

The older rocks which outcrop sporadically around the margins of the storage and underlie alluvium in deeper parts of the basin consist very largely of well compacted, weathered, fine sediments - shale, claystone and siltstone, in places calcareous and tuffaceous. Minor beds of sandstone are involved and some lenses of limestone occur, notably near the hospital at Acton. These beds are folded, cleaved and in places faulted. The downstream end of the storage southwest of the Deakin Fault (see Plate 1), lies in Painter Porphyry - a well-jointed and, in places, sheared igneous intrusive.

Leakage from the storage could only result from the passage of water through either porous formations or along fractures to emerge downstream from the basin. There is however no evidence to suggest significant leakage through the basement rocks under the comparatively low hydraulic pressure which will exist. The folded sediments are for the most part fine-grained and tight; most of the outcrops which will have direct contact with water are weathered and clayey. Lenses of limestone and possibly of sandstone occurring above the existing water table will take up water initially to fill cavities or porous beds, but they are surrounded by strata of low permeability. The sedimentary sequence is faulted against the Painter Porphyry toward the downstream end of the storage; the jointed porphyry is more permeable than most of the sediments, but water pressure testing of drill holes in this rock at the Yarralumla damsites clearly indicates that permeability in near surface zones and even in shears is low.

There is no evidence of major structures likely to induce leakage from the storage. Quartz-filled faults, within the sediments are likely to act as channels for ground water but none of these structures is known to cross the Deakin Fault and continue beyond the basin. The Deakin Fault itself cannot provide a leakage channel because the trace of the fault traverses high ground on either side of the storage; the water table along the fault on both sides of the storage will therefore be higher than the level of the lake itself.

The only localities where some leakage through the basement rocks is likely to occur is at the weir sites themselves, but these problems are discussed in a separate report.

### Superficial Deposits

Much of the superficial material is clayey and of low permeability; even some of the older gravels, occurring well above river level, contain a considerable amount of clay in their matrix and are less permeable than they appear at first sight; this has been proved by the water pressure testing of gravel on the left bank of one of the Yarralumla weir sites.

Superficial deposits could only provide channels for leakage from the storage where porous beds occupy a saddle or a ridge on the perimeter of the basin and extend below the storage level of 1825'. Examination of the storage indicates that, apart from the weir sites themselves, there is only one locality, a saddle near the entrance to Government House grounds, where alluvial terrace deposits may extend below the level of 1825' and could lead water out of the storage. This locality marked "A" on Plate 1 is under consideration.

On the left abutment of all three possible weir sites, alluvial terrace material including sand and gravel extends below the 1825' level; the investigation of this material in relation to leakage is covered in the report on weir sites.

In brief, the possibilities of leakage from the storage are restricted to one saddle near Government House, which is under examination, and to the weir sites themselves where specific measures against leakage would become part of the construction programme for the weir.

### LAKE MARGINS

The margins of the proposed lake were examined to determine the character of shores and slopes and the possible incidence of wave erosion and slippage.

In general, slips are only likely to occur around this storage where unconsolidated material forms a steep bank or lies as a veneer on steeply shelving bedrock. Slips could result under these conditions from undercut by erosion and or from sliding induced by saturation from a rising water table. The only effective source of erosion around the margin would be wind through the medium of wave action, particularly along margins exposed to the prevailing winds. However, wave action is most effective against steeply shelving banks, on gently sloping shores, waves break where depth approximately equals wave height, and the energy is dissipated with a minimum of erosion. The margins of Lake George provide good examples of the negligible amount of erosion which results from wave action in these cases.

The prevailing winds in Canberra are north westerly and south easterly, in that order of frequency, so that the head of storage, the north-eastern shore from about Scott's Crossing to Kings Avenue and the southern shore between Acton and Sullivans Creek would be the margins most effected. South easterlies will particularly affect the promontory on the north-eastern end of Commonwealth Bridge, the hospital promontory and the northern shores of the Sullivans Creek and the Black Mountain embayments.

However, no major problems would be expected in these areas because steep slopes or promontories, where wave action will be most effective, are invariably rocky with only thin soil cover; elsewhere these shores are gently shelving and not vulnerable to erosion. It might be noted **however** that the prevailing north-westerlies will produce waves and turbid water in the shallow area toward the head of storage.

There are however, a number of places around the lake shore where very minor slips could occur in gravel and sand; these are indicated by a cross on Plate I. These are only possible slips and do not appear of sufficient importance to warrant any stabilisation before the lake fills.

Mention has been made of the possibility of erecting low concrete walls along some parts of the shoreline; these would not be necessary to guard against erosion but could

improve appearance and decrease turbidity by establishing a minimum depth of about 3 ft. at the shoreline.

#### WATER TABLES

The filling of the storage to the 1825' contour will cause existing water tables to rise and seek equilibrium with the lake level. The rise will be greatest near the lake shore and the depth of the area, back from the shore, in which significant rise will occur will be a minimum where the slopes are steep and a maximum where the lake bank is gently sloped or flat.

The rise in water tables needs to be examined in reference to the flooding of underground service lines - sewer tunnels, telegraph lines, etc. - the water logging of foundations and basements and, in extreme cases, the killing of vegetation. The effect on service lines has been examined by the Department of Works and is not covered by this report; no localities were seen where the water table is likely to rise to within a foot or so of the surface to water-log existing plantations.

There appear to be only two areas along the shores of the lake where the rise of water table is likely to have any affect on existing or future building. These areas adjoin the southern shore in the vicinity of the new Administrative building and along Commonwealth Avenue. In both areas a considerable rise in the water table is expected although the only apparent disabilities arising are that service lines will lie below the water table and new and deep foundations, if any, would extend downwards into the saturated zone. The only existing building which will extend below the new water table is the new Administrative Building on King Edward Terrace, but in this case the building includes drainage and water proofing designed to meet the new conditions.

# GEOLOGICAL MAP CANBERRA CITY

