APPLIED ECOLOGICAL STUDIES OF SHORELINE VEGETATION AT LAKES MANAPOURI AND TE ANAU, FIORDLAND

PART 4: RECOMMENDATIONS

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These recommendations are aimed at providing the maximum water use for both Lake Manapouri and Lake Te Anau commensurate with the conservation of those features of their natural shorelines which provide ecological stability and a high aesthetic quality.

We have presumed that raising the level of Lake Manapouri by the proposed 27.5ft (8.4m) for an additional annual power output of only 4.5 per cent is not in the long-term national interest because of the losses and ecological problems it would create. Losses would include the present aesthetic quality and ecological stability of the natural shoreline, together with the unmodified vegetation on many of the smaller islands which, by providing a basis for assessment of deer damage in eastern Fiordland, are scientifically irreplaceable. Ecological problems associated with lake raising include renewal of a stable shoreline at the new level (this problem remains even if an acceptable standard of clearing of lake-shore vegetation can be achieved) and the possibility of landslides and minor subsidences through undercutting of soil around the new lake margin. In addition, there is the possibility of eutrophication caused by the addition of vast quantities of organic matter to the lake in the form of vegetation and soil.

The pattern of operation that had been planned for each lake (Fig. 1) obviously takes no cognizance of the curves expressing the probable maximum flood tolerance of the woody flora forming the shoreline vegetation. The recommended control level for Lake Manapouri—586ft or 178.6m—is below almost all of the shrub zone. For the woody vegetation to be retained as close as possible to its natural state the lake should occasionally reach its natural maximum but for any level above 586ft, the lake should be operated so as not to exceed the tolerance values given in Figure 2. Failure to operate the lake up to its natural maximum would encourage the successional tendencies apparent in the shoreline vegetation, thereby initiating a downward movement of scrub and forest communities.

The comparable curve for Lake Te Anau (Fig. 2) indicates that el. 665ft (202.7m) is the highest level at which the lake may be held for an indefinite period without destroying scrub and forest along about 66 miles (106km) of shoreline. We therefore recommend this value for its control level. Only small areas of manuka scrub would be submerged at this level and these probably would be killed if the level was maintained for more than about 250 days. Since this level is one which the lake has maintained continuously for up to 125 days during the 38-year period of recording, damage to the lake-shore forest through water table effects would be unlikely.

There is much less certainty regarding precise recommendations on the minimum interval between periods when the lakes are held above their control levels (Mark, *et al.* 1972). Even so, the frequency of flooding is likely to be as critical for survival of the woody vegetation of the shoreline as is the duration. Available information suggests that the minimum intervals for Lake Manapouri could be as follows: el. 591ft = *ca.* 180 days; 590ft = *ca.* 80 days; 589ft and 588ft each = *ca.* 40 days; 587ft = *ca.* 20 days. Comparable values for Lake Te Anau are: el. 670ft = *ca.* 180 days; 669ft = *ca.* 60 days; 668ft, 667ft and 666ft each = *ca.* 30 days.

A control level for Lake Te Anau of 668ft (203.6m) would, we predict, cause eventual destruction of all areas of adjoining swamp forest

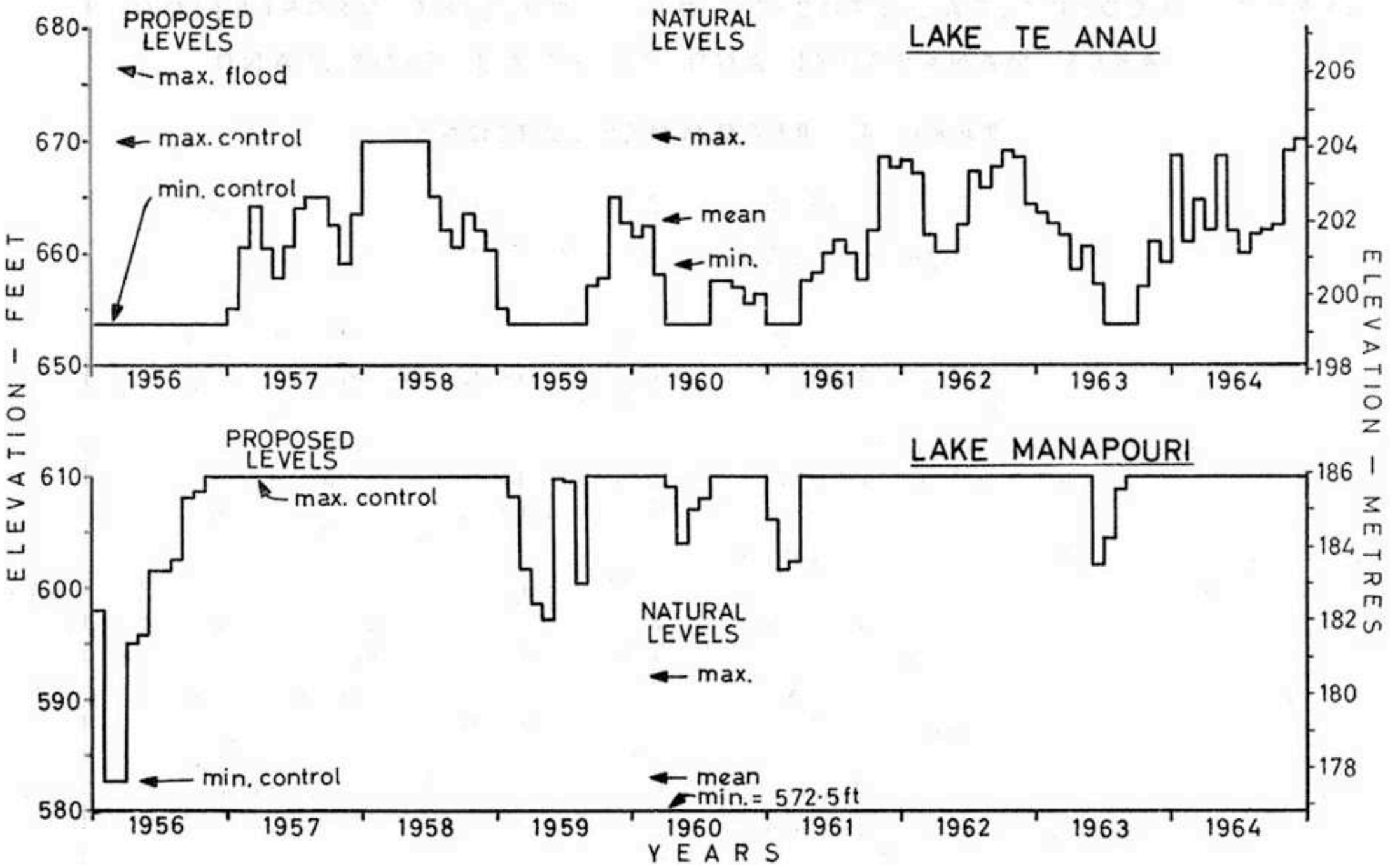

FIGURE 1. *Pattern of operation of the Lake Te Anau and Lake Manapouri levels as they would have been for a nine-year period. Values have been extracted from Bechtel Corporation and Ministry of Works calculations based on analyses of hydrological records for the period (Drawing No. 4589A-22-144). Both proposed and natural extreme levels have also been indicated. Note, the proposed control level for Lake Te Anau has now been reduced to 668ft.*

because of prolonged inundation. In addition, a water table maintained at this level for extended periods would probably destroy trees along the 66 miles of forested shoreline formed of loose unconsolidated material (computer runs, as shown in Figure 1, have indicated the control level would be maintained for up to eight months on end whereas under natural conditions the maximum duration at this level is only 22 days).

Any lake level higher than the natural maximum (670.5ft or 204.3m) would inundate trees around most of the 180 miles (290km) of forested shoreline and would soon prove disastrous. Therefore adequate precaution should be made to avoid this at all times.

In the absence of a detailed topographic survey we cannot assess the extent of damage at any particular control level but the 22 profiles described around Lake Te Anau (Mark, *et al.* 1972) indicate the relative damage at different levels. On sites with a moderate incline away from the shoreline (e.g. site 2 Pleasant Bay or site 17 Ettrick Burn) the strip of woody vegetation lost due to a 668ft (203.6m) control level may be only 10-30m wide. On extensive deltas however, as at the Lugar Burn or alongside the Clinton River opposite Glade House, destruction is likely to be much more extensive, possibly reaching up to 450m or in some cases even up to 900m from the shoreline. These values are based on horizontal

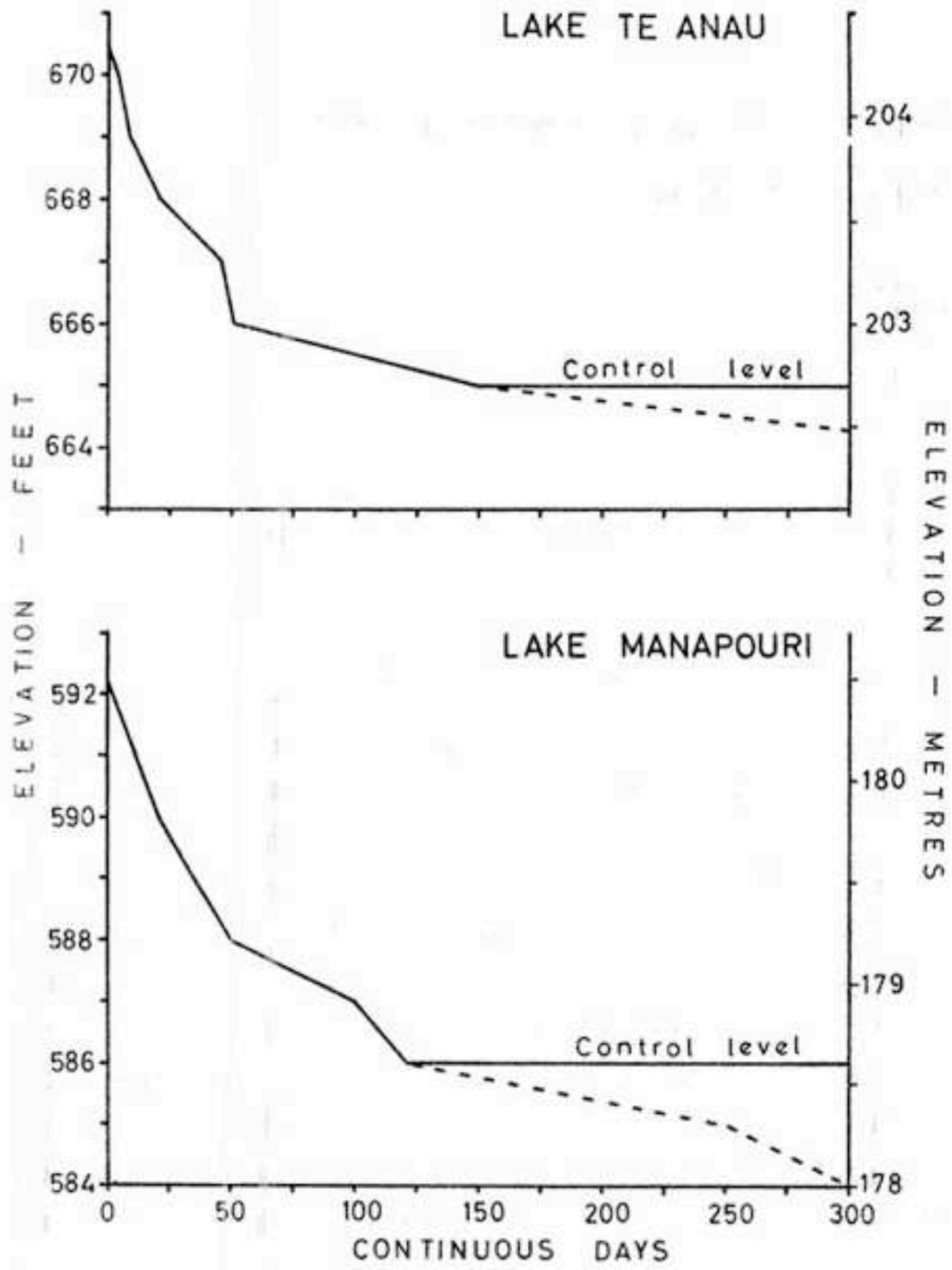

FIGURE 2. *Long term control levels (to the nearest foot) and operating pattern at high lake levels recommended for Lakes Te Anau and Manapouri. These curves are based on a 37-year daily record of lake levels and reflect the maximum tolerance to flooding of the woody vegetation along the shoreline of each lake.*

projection of a water table from a particular lake level, but given a water table higher than lake level, as has been recorded in Te Anau township, the water table effects could be even more extensive. Long-term ecological instability is likely to be initiated by any loss of the protective streamlined edge of the natural shoreline vegetation (see Mark, *et al.* 1972).

Finally, we strongly advise that the level of Lake Te Anau be controlled, initially at least, at any particular level above 665ft (202.7m), for periods only slightly in excess of those indicated in our recommended operating curve (Fig. 2). Any resulting damage would be apparent at least within a year, possibly much sooner, and should be carefully assessed before further exceeding either the recommended height-duration values or the minimum intervals between them which we have suggested. Such co-operation between engineers and plant ecologists would be invaluable for providing the type of information, so far lacking, that will achieve the necessary optimum balance between hydro-electric development and conservation of natural, stable, shoreline environments.

REFERENCE

MARK, A. F., CRUSH, J. R. & MEURK, C. D. 1972. Applied ecological studies of shoreline vegetation at Lakes Manapouri and Te Anau, Fiordland. Part 3: Vegetation of the Lake Te Anau shoreline. *Proceedings of The New Zealand Ecological Society.* 19: 143-156.