Memo on nutrient management in Lake Rerewhakaaitu

The basis of the request for this memo probably arises largely from a 1978 paper by Geoff Fish entitled "Lake Rerewhakaaitu - an apparently phosphate-free lake". Fish examined nutrient concentrations in inflows and in the lake. Concentrations of dissolved reactive phosphorus (DRP) were below detection limits in the lake in 1972-4 despite concentrations of DRP of around 25 mg m^{-3} and total phosphorus (TP) around 40 mg m^{-3} in the Mangakino Stream inflow, and consistently over 100 mg m^{-3} in the Awaroa Stream inflow. Both inflows were punctuated be some extremely high concentrations of phosphorus, presumably coinciding with storm flows. Concentrations of nitrate have increased in the MangakinoStream, from around 1 mg L^{-1} in Fish's study to around 3-4 mg L^{-1} nowadays. The Mangakino Stream inflow is the only one that flows continuously (around 20 L s^{-1}). On the basis of catchment area (from surface topography), it can be concluded that surface inflows represent a proportionately small constituent of the total discharge to the lake. Further complicating the situation, however, is that the lake is perched, with surface water levels being above local groundwater levels, and that groundwater within the surface topographic domain is connected with other catchments; the Rangitaiki and the Waikato Rivers. Application of areal rates of nutrient loss in nutrient budgets for Lake Rerewhakaaitu, as well as synthesis of discharges and nutrient concentrations in inflows for lake modelling (DYRESM-CAEDYM), needs to accurately represent the water budget with some accuracy and involves more than mapping surface topographic features.

Rerewakaaitu is the only lake amongst the Rotorua lakes where dairy farming is the predominant land use. Despite this the lake is mesotrophic and its trophic state appears to have remained remarkably unchanged since Fish's 1972-74 survey. Fish did note some depletion of dissolved oxygen in bottom waters during temporary stratification events and these have been evident in BOPRC monthly profiles on occasions. Without continuous monitoring it is difficult to surmise whether, and to what extent oxygen levels in the lake have changed but apparently not greatly.

Farmers have taken responsibility for attempting to improve nutrient retention on land in order to protect lake water quality. It is noted, however, that there is substantial soluble P use in the catchment; the average (based on SFF reports) is around 50 kg P ha^{-1} yr^{-1}. Recommended application rates are 90 kg P ha^{-1} yr^{-1} on volcanic ash soils. Loss rates (based on OVERSEER) have been estimated at 6 kg P ha^{-1} yr^{-1} but McIntosh used 2 kg P ha^{-1} yr^{-1} as a basis for a nutrient budget which would include attenuation and losses of P due to water from farms not entering the lake.

I see four possible questions for the TAG:

1) Do we need to quantify the hydrology more accurately than what is known at present?

2) Should we monitor DO (and stratification) continuously?

3) Should 'we' focus on (i.e. have targets for) P and simply have best practice for N?

4) Should we look at the sensitivity of lake sediments to anoxia?