Lake Taupo – threat from delayed impact of land use via old groundwater inflow

U. Morgenstern*, J. Hadfield, B. Vant****

*GNS Science, PO Box 30368, Lower Hutt 5040, New Zealand, u.morgenstern@gns.cri.nz
**Environment Waikato, PO Box 4010, Hamilton East 3247, New Zealand

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Background

The near pristine water of Lake Taupo is under threat, mainly as a result of the delayed arrival of nitrate from farming. Nitrogen travels from farms to the lake mostly via groundwater, entering the lake via groundwater-fed streams, and directly by groundwater seepage via the lakebed. By measuring the age of the ground- and streamwater, we can calculate the future nutrient load adjustment to current landuse. Streamwater is relatively easily accessible for testing. Groundwater seepage directly through the lakebed in the northern part of the lake is, however, more difficult to test but this water poses the largest threat of future nutrient load increase to the lake (Hadfield 2007, Morgenstern 2007).

Methods

In all the larger streams of the northern and western Lake Taupo catchment we measured tritium time-series data over a period of 10 years to establish the time delay between water infiltration into the ground, and discharge into the lake. To establish the age of the lakebed seepage water, we installed two piezometers in the lakebed near Kinloch, one of the main groundwater seepage areas identified by NIWA (Gibbs et al. 2005). Stream and seepage groundwater was sampled for isotope and chemistry analyses to establish the age distribution of the groundwater, future arrival of landuse-impacted water, and estimate future nitrogen load from past landuse activities.

Results

The mean residence time of the streamwater is approximately 60 years in the northern catchment, 40 years in the western catchment and only a few years in the southwest near the andesite formation. Nitrate-N concentrations are approximately 0.6 mg/L. The seepage water is older than that of the surface stream flows with mean residence times of c.50 and >130 years. The seepage water is oxic, with nitrate-N 0.25 and 0.28 mg/L.

Conclusions

The medium age stream waters in the northern and eastern catchment are mostly adjusted to current landuse. In addition to the current nitrogen load of c. 300 t/y via streamwater, an increase to c. 350[1] t/y is expected once all *the landuse impacted water has worked its way through the groundwater system and has replaced all of the* pristine pre-landuse water. The older lakebed seepage water is still low in nitrate according to pre-landuse recharge conditions. However, significant nitrate load increases must be expected with the arrival of landuse-impacted water through the seepage. Nitrate attenuation is expected to be minor, the seepage water is oxic. A nitrogen load of >150 t/y is estimated for the lakebed seepage water. The total nitrogen load increase in the northern and western catchment of Lake Taupo due to past landuse activities is significant, it is expected to increase from currently c. 300 t/y to >500 t/y. A significant decline of lake water quality must be expected once the nitrogen load to the lake has adjusted to past and current landuse activities.

The above predicted loads are estimates. To obtain more accurate predictions of future nitrogen loading to the lake we are planning another investigation of the

stream water, and to install more piezometers in the lakebed to obtain a more representative set of groundwater seepage samples.

References

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[1] previously lower estimate of 310 t/y was revised after availability of further tritium data for more robust age interpretation