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Time trends in groundwater chemistry and future nitrate load

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Because of declining water quality due to delayed impact of land-use intensification in the Lake Rotorua catchment, hydrochemical and age dating measurements were made at major springs and streams draining Lake Rotorua catchment to assess the past and the current states, and future trends in water chemistry.

The volcanic aquifers in the Rotorua area have large water storage capacity and therefore have the potential to delay the impacts of land-use intensification on lake water quality. Because of the hidden nature of groundwater and it's long residence time in the aquifer, extensive groundwater contamination can occur unrecognised over long time periods. Progressively, the old pristine groundwater is being replaced by younger impacted water, which then discharges into the streams and lake. Nutrient-enriched groundwater travels from pastoral land to springs and streams, and to the lakes. Most of these groundwaters are relatively old, with mean residence times over 50 years. Trends in hydrochemistry indicate that only three analytes in the groundwater, nitrate, potassium and sulphate, are impacted by land-use intensification. These analytes all have increased concentration in young groundwaters.

Nitrate concentration, the major contaminant, is significantly higher for water recharged after land-use intensification. The natural background level of NO_3-N (before land-use intensification) is assessed to be 0.13 mg/L, and the current recharge level to be 1.6 mg/L. Therefore, 92 % of the NO_3 in the young groundwater is derived from the land-use in the catchment. This is an increase by a factor 12 above natural background.

Further increases in nutrient load are expected in the future for the large old water fractions. Land-use impacted water carrying high nitrogen loads (NO_3 is the major nitrogen component) will increasingly discharge into the lake as the old pristine water is depleted. The current total nitrogen concentration of Lake Rotorua is 0.45 mg/l. Some major springs already discharge water to the lake with 0.7-1.4 mg/L NO_3-N. These are expected to increase to about 1.6 mg/L. The nitrogen concentration in the lake is therefore expected to continue to increase until steady-state is reached.