Water Quality in the Rotorua Te Arawa lakes

Information Sheet 3

The Rotorua/Te Arawa lakes are the jewels of the central North Island, but many of the lakes have too many nutrients.

Nutrient loads to the lakes have increased markedly over the past few decades. The main causes are:

- Land use activities, particularly intensive farming.
- Sewage from lakeside communities.
- Large amounts of nutrients stored in the bottom sediments of some lakes which come from historical practices such as the discharge of treated sewage into Lake Rotorua.
- Groundwater aquifers that are being progressively enriched with nutrients from historical farming practices that will continue to feed into the lakes over coming decades.

A number of other factors that must be considered for restoration actions to improve lake health:

- Most of the water entering the Rotorua lakes has spent considerable time underground and because of this, restoring water quality will take a prolonged effort.
- Our understanding of the issues and appropriate treatment methods to restore water quality continues to evolve with the monitoring and restoration actions taken.
- Long-term actions to reduce nutrient loads from lake catchments are essential but may be supplemented by immediate actions, such as the Ōhau Channel diversion wall, to bring rapid improvements in water quality.
- As water quality improves and light reaching the lakebed increases, weed growth is likely to increase.

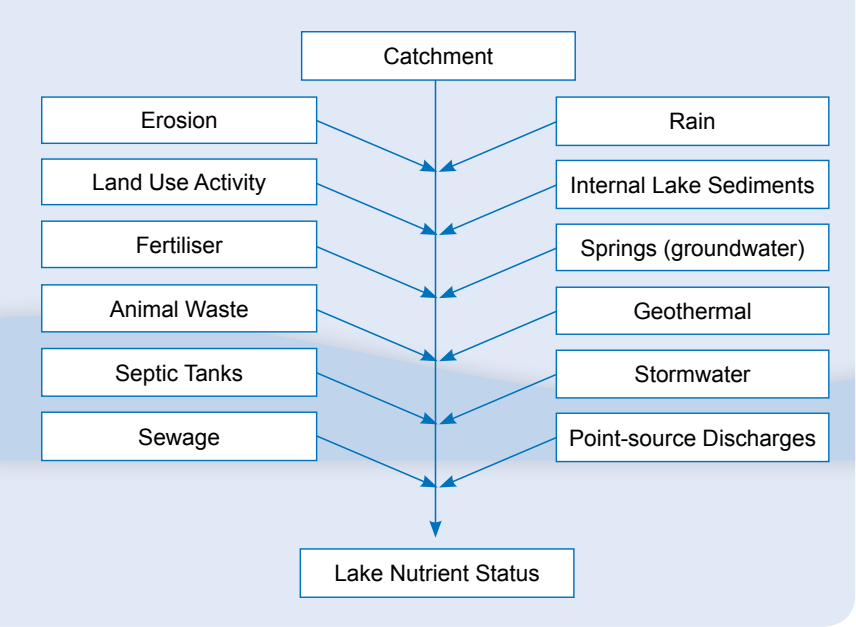
To improve water quality, nutrient levels in our groundwater need to be reduced. Better land management practices and changes in land use are two ways to counteract the degradation of the lakes.

To achieve better water quality we are using a range of mechanical, chemical and biological methods. Many of these methods, such as changes in land management practices will take years or decades to have an effect, but some of the methods such as phosphorus locking will show more rapid results.

There is no single quick solution to improving the water quality across all of the lakes.

Nutrient inputs

Algal growth in the Rotorua lakes depends on a variety of essential elements (nutrients). The two most common nutrients that promote algal growth are nitrogen and phosphorus. Levels of these nutrients in many of the lakes are too high and need to decrease to reduce algae concentrations and blooms. It is important to know where these nutrients come from. The diagram lists the main nutrient sources.



Main nutrient input sources

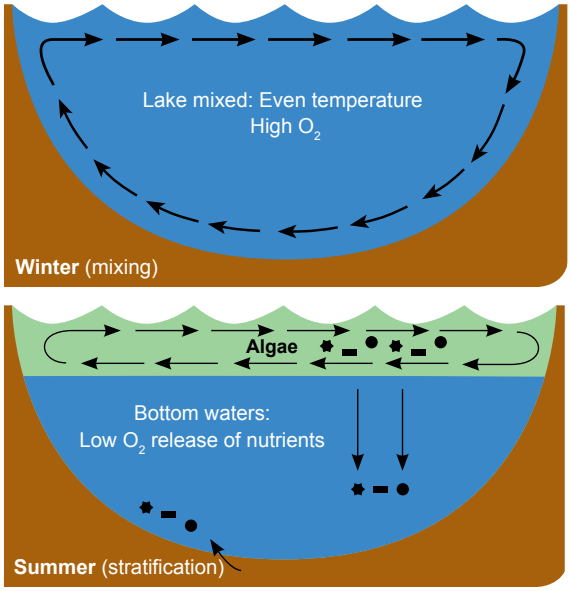
Lake dynamics

Water quality in the Rotorua lakes is governed by complex interactions between physical, chemical and biological processes.

Waters in the deeper lakes such as Tarawera, Rotoiti and Rotomā mix fully from top to bottom in winter when the surface waters cool and warmer water below then rises. Dissolved oxygen levels in surface waters of lakes usually remain relatively stable because oxygen losses from respiration are replenished by gains from the atmosphere or photosynthesis of aquatic plants.

However, during warm, calm periods in summer and autumn, the lake waters stratify, with dense, cold bottom waters trapped beneath warmer surface waters. In shallow lakes such as Rotorua, Rotoehu and Rerewhakaaitu, stratification occurs temporarily, for only a few days at a time.

When lake stratification occurs, oxygen in bottom waters is not replenished adequately because atmospheric inputs are cut off and there is insufficient light for photosynthesis. In low-oxygen conditions, nutrients such as phosphorus can be released from the lake sediments. Remixing of the waters in autumn can bring these nutrients to the surface where they can stimulate algal blooms. Increased algal growth in the surface waters results in further deposition of algae on the lake bed, further fuelling the cycle.



Seasonal differences in temperature, light, plant growth and nutrient availability may result in stratification of lake waters.

Bay of Plenty Regional Council uses the rate of decline of oxygen in bottom waters of deep lakes as an indication of water quality trends, amongst lakes and within individual lakes, to complement other water quality indices.

Algae in the Rotorua Lakes

Algae are a vital component of lake ecology, producing food for higher levels of the food chain as well as oxygen to sustain life in the lake. Algae contain chlorophyll-*a*, a green pigment which enable them to use the sun's energy to build up biomass and sustain the food chain.

Blue-green algae (cyanobacteria) are a group of bacteria, rather than true algae, that have acquired chlorophyll and behave like plants. Blue-green algae are present naturally in lakes but may congregate into surface blooms when the water is calm. Some blue-green algae can fix atmospheric nitrogen which increases their growth rates.

Restricting nutrient supply to the lakes is the key to reduce the frequency of algal blooms. Nitrogen and phosphorus are especially important nutrients in the Rotorua lakes. They are present naturally at levels below optimal for the growth of algae. If you live in one of the Rotorua lakes catchments your activities will have a bearing on nutrients draining into a lake, which affects algal growth and water quality.

Bay of Plenty Regional Council conducts regular monitoring of algae in Rotorua lakes as part of its blue-green algae monitoring programme. The monitoring programme provides information to the public to ensure lakes are safe for water-based activities and do not have high levels of toxins that are produced by some cyanobacteria.

The results are reported to the Medical Officer of Health at the Toi te Ora - Public Health Service, who will decide on whether a public health warning is required.

Trophic Level Index

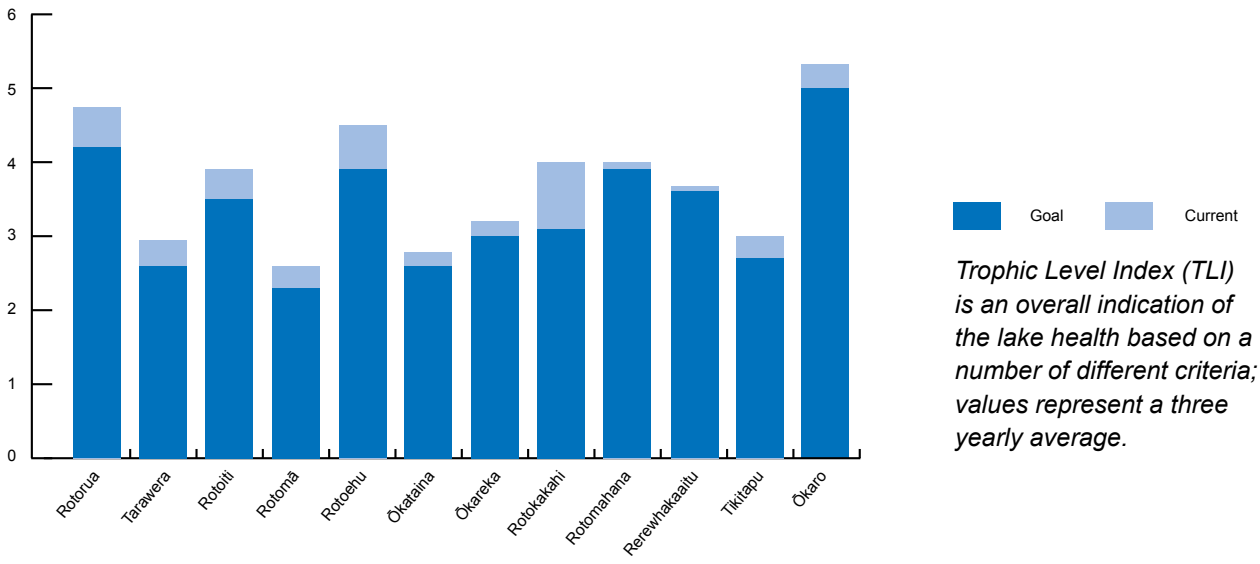
The Trophic Level Index (TLI) is a way of measuring water quality based on the amount of total nitrogen, total phosphorus and algae present in a lake, as well as the clarity of the water.

A TLI less than 2 indicates very good water quality. A TLI greater than 5 indicates very poor water quality. The higher the TLI, the greater risk of environmental problems like algal blooms and unusual foams.

The TLI is accepted throughout New Zealand as a measure to indicate water quality. The Ministry for the Environment uses the TLI as a national level lake water quality indicator.

The Regional Council has calculated a TLI for each of the lakes in the Rotorua area to assess the overall health of each lake. The TLI for each lake is compared over time to see if water quality is getting better or worse.

Current (2010/11) TLI Values for all lakes



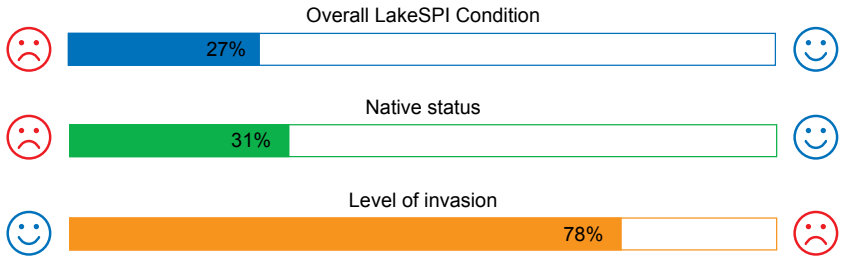
Trophic Level Index (TLI) is an overall indication of the lake health based on a number of different criteria; values represent a three yearly average.

Other ecological indicators - LakeSPI (Submerged Plant Indicators)

The LakeSPI (submerged plant indicators) provide a measure of how the distribution of submerged lake plant communities change over time and how the percentage cover of native submerged plants alters in the presence of invasive submerged plants. Bay of Plenty Regional Council, working in tandem with NIWA, uses standardised LakeSPI (pronounced “Lake SPY”) indices for measuring the health of submerged plant communities.

Samples are taken from Rotorua lakes over a staggered two-year period (six lakes each year). The resulting LakeSPI index shows the overall measure of each lake’s native and invasive condition. This methodology focuses on the littoral margins (edges) of lakes where public access and interaction is greatest.

By examining the distribution of submerged plants, LakeSPI also provides us with additional information on a lake’s long-term water quality trends. Trials have been conducted with incorporating a faunal component into LakeSPI, where the distribution and abundance of koura (freshwater crayfish) and kakahi (freshwater mussels) are monitored in the lakes over time.



(Rotorua 2009 – source NIWA)

Example of a LakeSPI summary. These results are based on samples taken from Lake Rotorua during 2009. In this example the overall condition is poor, with a low level of native plant species and a high level of invasive pest plant species.

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