

## Lake actions, risks and other options

The Rotorua Lakes Programme is now experiencing a level of success not expected more than three years ago. The priority lakes are showing significant improvement to such an extent that they are now meeting or very close to meeting their Water and Land Plan TLI objective. Lake Rotorua met its TLI objective in 2012 and was marginally higher in 2013. Lake Rotoiti has now met its TLI objective mainly as a result of the diversion wall. Lake Rotoehu is close to its TLI objective as a result of a number of interventions. Lakes Ōkāreka and Ōkaro have also been the subject of restoration interventions, but the improvements have not been as significant as observed for the first three lakes mentioned.

For each lake the type of intervention has been selected to suit the specific needs of the lake and its catchment. Not all interventions are suitable for every lake, and success from any action is likely to have been lake specific. For example the main intervention for Lake Ōkāreka has been sewage reticulation, whereas for Rotoiti it has been the diversion wall, for Rotorua it has been alum dosing and for Rotoehu it has been weed harvesting and alum dosing.

With the rapid success we have experienced it is now becoming clear that the community would find it unacceptable to think that the water quality in the lakes could be allowed to decline. There is however, a risk that water quality could decline in any of the lakes either because of factors outside our control such as climate effects, incursion of a new algae species, weed growth as a result of improved light penetration, as well as failure of any of our current interventions. For example alum dosing is a major component of success in water quality improvement in Lake Rotorua. Certain groups within the community have indicated dissatisfaction with the use of alum for lake restoration. Although we continue to undertake research to test for risks around the use of alum to the aquatic fauna, we require resource consent for the dosing programme and there is a risk in the future that resource consent may not be obtained.

It should be noted that the programme is ultimately based on long term management of each lakes contributing catchment to ensure that land use within any catchment is sustainable and will result in the lake reaching its target TLI. Other in lake interventions are in many circumstances designed to accelerate the improvement of water quality within any lake and so are generally targeted at the more eutrophic lakes.

To ensure that we are well informed as to our options it is important for the programme to be identifying alternative options not only for the protection of the other lakes not yet subject to any interventions but also identifying better or alternative options that could be substituted for current interventions. This could be because the alternatives may provide a better solution, or may be necessary because the initial option has become unacceptable for some reason.

It is opportune to review the actions being implemented on each of the lakes and identify potential risks and potential solutions or options to replacement actions to avoid those risks. This may also identify the need to research new techniques that could emerge as alternatives to current actions.

The following is a table listing current interventions along with potential risks to the programme:

Lake	Intervention	Targeting	Risks	Alternatives
Rotorua	Alum dosing two streams	Phosphorus, in stream, in lake and sediment	Resource consent not renewed, ecological effect identified, community opposition	Aeration, being tested Rotoehu, nanobubbles local soils, other products (Aqual P)
Rotorua	Zeolite removal of N from Tikitere	Nitrogen, up to 30 T	Not as effective as expected.	De-nitrification process trialled and discounted. Other possible in-lake options?
Rotorua	Floating wetlands	Nitrogen and phosphorus	Minor impact on nutrients	Land based wetlands, other N interventions?
Rotorua	Sewage reticulation and treatment	Nitrogen and phosphorus	Exceedance of the 30 T load, increase in P inputs	That is being assessed by sewage working party now
Rotorua	Long term land use P and N reductions (gorse removal and Land use change)	Nitrogen and phosphorus	Insufficient reductions, and actual inputs are higher than predicted	Increase targets, and/or rely on more in-lake interventions
Rotoiti	Diversion wall	Nitrogen and phosphorus	Resource consent issues 2017	Modelling to check risk if removed while Rotorua at varying TLIs.
Rotoiti	Sewage reticulation and treatment	Nitrogen and phosphorus	Only ½ lake reticulated	Sewage working party advising currently.
Ōkāreka	Sewage reticulation and treatment	Nitrogen and phosphorus	Does not remove enough N or P	NA
Ōkāreka	Land use change	Nitrogen and phosphorus	Only 100 Ha completed, may not be enough, monitoring required to check	Further land use change and gorse removal
Ōkaro	Constructed wetland	Nitrogen and phosphorus	Insufficient nutrient removal	More detention dams, increase wetland area
Ōkaro	Land use change	Nitrogen and phosphorus	Insufficient area converted, 28 Ha to forestry	Convert more land to lower nutrient footprint
Ōkaro	Alum dosing and Aqual P	Phosphorus	P inputs still too large for dosing control (from sediments and catchment)	Aeration of hypolimnion
Ōkaro	Land management	Nitrogen and phosphorus	Insufficient action and changes to achieve targets	More land use change, rely more on in-lake interventions