A Statement of the Significance of Disposal of Treated Wastewater in the Management of Lake Rotorua

Rotorua Lakes: Water Quality Technical Advisory Group

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Introduction

1. This statement is addressed to any parties with an interest in water quality of Lake Rotorua, particularly as it relates nutrient loads from treated wastewater. It has been prepared following discussions by members of the Water Quality Technical Advisory Group (TAG) established by BoPRC, TALT and RLC to assess technical aspects of lake research.
2. The TAG understands that RLC will stop spray irrigation of treated wastewater in Whakarewarewa Forest by 2019, and is investigating alternative disposal options. The options include the Puarenga Stream, Lake Rotorua and land elsewhere.
3. We note that discharge to the Kaituna River has been ruled out. We agree with this and reflect on the extensive canvassing of alternative methods of waste water disposal that occurred in the 1980s.
4. The TAG notes that early expectations around P storage have largely been met and that there is additional storage available in many locations within the forest. The Rotorua Land Treatment System (RLTS) has reduced P loads from treated waste water below the consent condition since irrigation changed from a weekly to a daily cycle. There is potential, however, for some of the stored P to be lost as a result of soil erosion following harvesting coinciding with heavy rainfall events, and recent modelling indicates a risk of increased P losses.
5. The TAG acknowledges that the land treatment system has not consistently achieved the level of nitrogen reduction that was intended and therefore subsequent upgrades of the wastewater treatment plant were required; these upgrades have reduced loadings to Waipa Stream over time; and that the system complies with its consent conditions re nitrogen reductions in the absence of high annual rainfall.

   The TAG would like to ensure that adequate consideration is given to the potential for alternative disposal options to impact on other stakeholders and on initiatives to maintain or improve water quality in the Puarenga Stream, Lake Rotorua, the Kaituna River and the Maketu Estuary.

6. The TAG supports the Lakes' Council's goal to find a long-term sustainable solution to waste water disposal, and would support an alternative discharge that meets the goals of no significant increase in the total load of nitrogen and phosphorus to the lake from current levels, and does not compromise meeting the sustainable Lake Rotorua nutrient targets for N and P from the lake catchment.
7. The TAG believes that land disposal offers significant benefits, especially to help meet P load targets, in combination with waste treatment.

Background

8. In 1991 the Rotorua District Council was granted consent to discharge treated wastewater by spray irrigation in Whakarewarewa Forest. Variations to the consent were recently granted. At the time the consent was granted Whakarewarewa Forest was Crown land. The current Consent (No. 60739) is due to expire in 2021.
9. Under the 2008 settlement of a Treaty of Waitangi claim, ownership of Whakarewarewa Forest was returned to iwi.
10. RLC has signed a Deed of Understanding with CNI Forest Management Limited, which commits to cease spray irrigation in Whakarewarewa Forest by 2019. Alternative disposal locations are being considered including discharge to the Puarenga Stream or Lake Rotorua, and these may necessitate additional treatment at the wastewater treatment plant.
11. The TAG is mindful that the decision to stop spray irrigation requires alternative nutrient removal processes, and that discussion on these need to be pursued with urgency to maintain the current trend of improving lake water quality and contribute towards meeting the sustainable nutrient load targets for the lake.

History

12. Eutrophication of Lake Rotorua first became evident in the early 1960s when introductions of invasive macrophytes (oxygen weeds) began causing access and aesthetic issues, and phytoplankton 'blooms' occurred caused principally by greater loads of phosphorus and nitrogen.
13. During the 1960s the Rotorua City Council (RCC) upgraded sewerage reticulation in urban areas and built a wastewater treatment plant (WWTP) to replace septic tanks. The WWTP was commissioned in 1973 and discharged to the Puarenga Stream close to where it flows into Lake Rotorua. Concerns about eutrophication in Lake Rotorua led to stringent consent conditions on the amounts of nutrient (N and P) that the WWTP could discharge.
14. During the 1970s and 1980s the Rotorua City Council (which later became the Rotorua District Council and is currently known as the Rotorua Lakes Council) installed tertiary treatment to control nutrient loads to the lake, including alum dosing to remove P. However, consented nutrient load limits were not met consistently during the 1980s due to technical and cost constraints. In the late 1970s it was found that wastewater nutrients comprised a significant fraction of the total N and P load to the lake, and this led to pressure from stakeholders to remove wastewater discharges to the lake.
15. The diversion of treated wastewater away from the lake and its discharge into the Kaituna River below Okere Falls was promoted by NWASCA as part of the Upper Kaituna Catchment Control Scheme. While this option would have had benefits for Lake Rotorua, scientific investigations identified adverse impacts on the Kaituna River and Maketu Estuary. The Kaituna diversion was strenuously opposed by Ngati Pikiao on cultural grounds, and they took the matter to the Waitangi Tribunal. The Waitangi Tribunal recommended that the Kaituna option be dropped, and the government agreed.
16. The TAG understands that the Rotorua Project Steering Committee (RPSC) decided to include discharge to the Kaituna River as a potential option for the initial consultation, but the Cultural Assessment Sub-committee of the Rotorua Project Steering Committee (RPSC) sought to re-visit that earlier decision, and the RPSC unanimously supported a motion to have the upper Kaituna removed from the proposal as a potential discharge location. The TAG supports this decision.

17. Following the Waitangi Tribunal recommendation in the 1980s, a number of alternative disposal options for treated wastewater were investigated, of which the most effective was deemed to be a combination of tertiary wastewater treatment followed by land disposal.

18. The Rotorua Land Treatment System (RLTS) was commissioned in 1991 and included tertiary treatment of wastewater (using the Bardenpho process) based on spray irrigation onto 220 ha of plantation trees in the Whakarewarewa Forest, with the dual aims of reducing the nitrogen and phosphorus loads entering Lake Rotorua in a way that was acceptable to the community at the time.

Land Treatment Performance

19. The allophanic soils are volcanic in origin, sandy and well drained, with a large capacity for retention of applied phosphorus. Early expectations around P storage have largely been met. Most of the P of wastewater origin has been fixed in top 70 cm of the soil profile. There is ample additional storage available in locations where the depth to groundwater is greater than 70 cm and in the relatively small and currently un-irrigated reserve areas that were originally set aside for system expansion.

20. Figures 1 and 2 below show the level of - phosphorus derived from wastewater estimated to reach the Waipa stream and phosphorus concentrations in the Waipa Stream respectively.

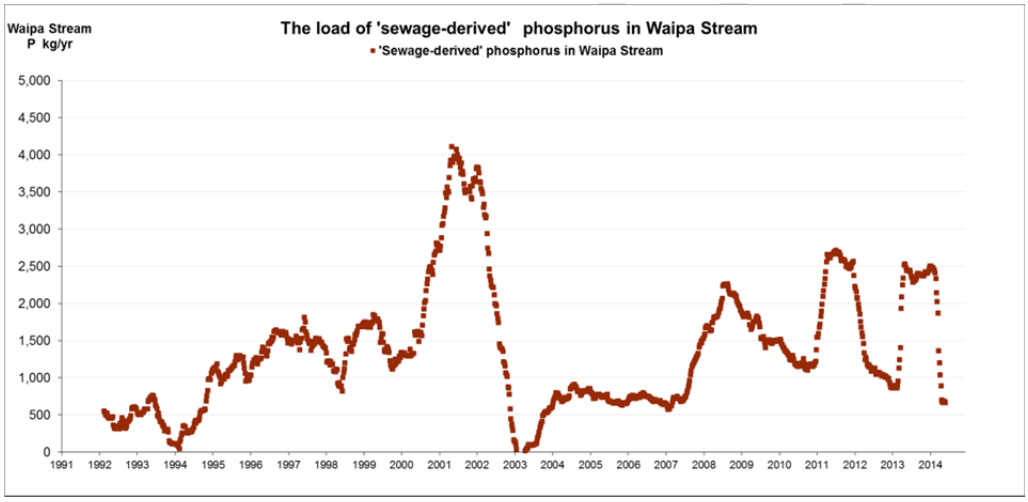


Figure 1. Loads of total phosphorus in the Waipa Stream derived from treated wastewater in the Waipa catchment, 1991 to 2015.

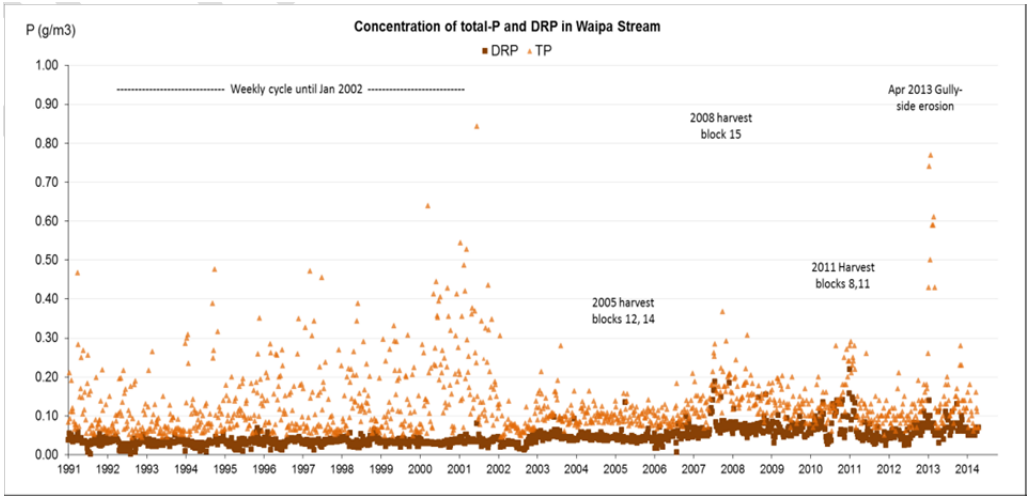


Figure 2. Concentrations of total and dissolved reactive phosphorus in the Waipa Stream, 1991 to 2015.

21. The RLTS has generally reduced P loads from wastewater well below the consented limit of 3 tonnes per year, particularly since irrigation changed from a weekly to a daily cycle. The annual storage rate of P has not changed appreciably over time, averaging 133 kg/ha/year (corresponding to 25.6 t/year at the RLTS) from 1991 – 1995, and 127 kg/ha/year (corresponding to 24.5 t/year at the RLTS) from 1995-2012 based on measurements to 100-cm depth. There is potential, however, for some of the effluent-origin P to be lost as a result of soil erosion following harvesting. Recent modelling (Pers. comm.: Prof David Hamilton, University of Waikato) indicates a risk of increased P losses from the RLTS. Increased concentrations of P in the Waipa Stream appear to have been associated with sediment movement in the RLTS area and may be connected with erosion and harvesting operations during heavy rainfall events.

22. Removal of applied N within the RLTS was expected to occur as a result of plant uptake and microbial denitrification along stream margins and wetland areas. Early expectations around N removal by tree uptake and through denitrification processes have not been met. Soil N stocks increased initially, but little additional N has been stored in the soil since 1995. N losses from the RLTS increased over time until they reached, and at times exceeded, the consent limit (30 tonnes per year). The Bardenpho process was unable to consistently meet the design load reductions for N discharged to the RLTS and it was extended in 2006. Carbon was added that reduced the N load applied to the RLTS down to the design load, but this was still not sufficient to achieve the 30 t/year consented wastewater load limit in the Waipa Stream. For example, in 2011 N losses from the RLTS were 37.5 tonnes per year. More recently the commissioning of the Rotorua MBR plant, has reduced the nitrogen loads applied to the forest so that the consent limit is being complied with at the volume currently being applied, and in the absence of a high rainfall year.

23. There have been positive and negative effects on the tree crop as a result of the RLTS operation. Radiata pine productivity has increased by around 20% (Beets et al. 2014) in upland areas in response to irrigation with wastewater, primarily as a result of improved soil N and P fertility; however, foliar diseases were evident on small trees. Excessive tree mortality occurred in stands of Douglas fir, and of radiata pine adjacent to the corridors where the over-ground pipework was laid, and in lowland areas where irrigation resulted in anoxic soil conditions.

24. Negative effects of wastewater on tree growth and soil P losses could be mitigated (Beets et al. 2014) by not irrigating areas where soils are likely to become anoxic or are erosion-prone, by delaying irrigation until trees are about 4 years old, by re-planting at high stem densities, and by not replanting in permanently wet areas. This would require additional land in conjunction with changes in the crop management regime.

    BoPRC is currently seeking to reduce nitrogen inputs from the catchment by 270 t per year through controls and incentives on land use. If a total N discharge of 30 t per year is not achieved, then in order to meet the target of 435 t N per year, other sources of N reduction would need to be identified.

26. The TAG would like to emphasise that in the selection of any new treatment process or disposal options, the risk around increasing nutrient loads (N and P) to the lake is given full consideration and the target should be to maintain or improve the quality of treated waste water that is discharged to the environment with the objective of supporting the Rotorua Lakes Program in reaching the long-term lake TLI target.

Conclusions

a. The treatment and disposal of Rotorua City waste water since 1991, when the Bardenpho plant and the forest irrigation area were commissioned, has been the single most successful intervention to reduce the catchment nutrient loads reaching Lake Rotorua in its history.

b. The WQTAG acknowledges that there would be a significant cost associated with either continuing the current land treatment system or developing a new one.

c. The WQTAG supports the Rotorua Lakes Council goal to find a long-term sustainable solution, and would support wastewater treatment with an alternative to a discharge to land subject to it being low risk and the most practicable option when consideration is given to relevant environmental, social, cultural and economic aspects.

d. The TAG believes that land disposal offers environmental benefits, especially to help meet P load targets, in combination with waste treatment.

e. The WQTAG acknowledges that the future growth of Rotorua needs to be considered and seeks that due consideration is given to the risks and sustainability of any proposed alternative treatment and disposal system because of the risk of increasing the load of nutrients to the lake.

f. Whatever option is chosen should not hinder the achievement the target nutrient loads for Lake Rotorua.

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