FIFTH DRAFT

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

Rotorua Lakes: Water Quality Technical Advisory Group

14 January 2015

Introduction

1. This statement is addressed to the Rotorua Sewage Technical Advisory Group (RSTAG)and to be made available for senior managers in Bay of Plenty Regional Council (BoPRC), Te Arawa Lakes Trust (TALT), Rotorua ~~District~~ Lakes Council (RL~~D~~C), ~~Central North Island Iwi Holdings Ltd (CNI), Tūhourangi Tribal Authority (TTA)~~ and other parties who have an interest in the treatment and disposal of Rotorua ~~Land Treatment System (RLTS).~~City wastewater. It has been prepared following discussions by members of the Water Quality Technical Advisory Group (WQTAG) established by BoPRC, TALT and RDC to assess technical aspects of lake research.
2. The WQTAG understands that RL~~D~~C and CNI have signed a deed of understanding for RL~~D~~C to stop spray irrigation of treated wastewater in Whakarewarewa Forest by December 2019.
3. The WQTAG also understands that RL~~D~~C, through its consultants Mott MacDonald Consulting Engineers, is investigating alternative options including upgrading treatment at the WWTP followed by discharge either: direct to water in the Puarenga Stream or Lake Rotorua; or to water via wetlands, rapid infiltration beds, riparian/gabions or natural ponds; or to land elsewhere in the catchment. *Note that discharge to the Kaituna River has been ruled out of the options.
4. The WQTAG acknowledges that the land treatment system did not achieve the nitrogen reductions as designed and therefore subsequent upgrades of the wastewater treatment plant were required at a significant cost to the community. The WQTAG notes that land treatment has been effective in ~~helping~~ achieving~~e~~ the required phosphorus reductions.
5. The WQTAG notes that:
    a. land use intensification in the wider Lake Rotorua catchment has resulted in nitrogen inputs to Lake Rotorua from land increasing since the RLTS was commissioned,
    b. alum dosing has reduced phosphorus inputs from the Utuhina and Puarenga Streams in recent years, and
    c. as a result Lake Rotorua may have moved from being ~~consistently~~ regularly nitrogen limited in the 1970-1980s towards being phosphorus limited.
6. The TAG would like to ensure that adequate consideration is being given to:

a. the benefits of land disposal of treated sewage effluent, notwithstanding some failures to achieve the required nitrogen removal and some problems with tree health,

b. the potential for alternative disposals options to impact on other stakeholders and on initiatives to maintain or improve water quality in Lake Rotorua, the Kaituna River and Maketu Estuary, and

c. the extensive canvassing of alternative methods of waste disposal that occurred in the 1980s.

7. The WQTAG supports the LakesDistrict Council's goal to find a long-term sustainable solution, and would support an alternative to a discharge to land subject to:

   a. no significant increase in the load of nitrogen to the lake;

   b. a minimal risk of an increase in the load of phosphorus to the lake;

   c. the likely load of phosphorus to the lake not exceeding 2 t/yr, and

   c.d. Where the sewage derived load of N or P to the lake does increase that RLC mitigates the increase by reducing the N or P load from some other contributing source.

Comment [Anon1]: These points could be replaced by stating that performance of proposed discharge options should be equal to or better than current wastewater loads of phosphorus and nitrogen to Lake Rotorua.

Background

8. In 1991 the Rotorua District Council was granted a consent to discharge treated wastewater by spray irrigation in Whakarewarewa Forest. At the time the consent was granted Whakarewarewa Forest was Crown land.

9. The initial consent have been replaced by consent 60739. Variations to the consent ~~were~~ have recently been granted. The current Consent (No. 60739) is due to expire in 2021.

10. Under the 2008 settlement of a Treaty of Waitangi claim, ownership of Whakarewarewa Forest was transferred to the CNI and the Tūhourangi Tribal Authority. The Tūhourangi Tribal Authority is an affiliate entity to Te Pumautanga o Te Arawa which has the mandated authority to receive and care for the Treaty of Waitangi settlements relating to the Hapū of Tūhourangi. Tūhourangi lands include Moerangi which encompasses the Whakarewarewa forest.

Comment [AL2]: Dave Donaldson?

Comment [AB3]: I think we need to confirm this, it is my understanding that the irrigation area was also transferred in part to Ngāti Whakaue.

11. The WQTAG understands that a court mediated agreement was reached between….

12. The WQTAG also understands that RLDC has signed a Deed of Understanding with CNI to cease spray irrigation in Whakarewarewa Forest by 31 December 2019 and is currently investigating alternative options including tertiary treatment followed by discharge to the Puarenga Stream or Lake Rotorua or to land elsewhere in the catchment.

Comment [AL4]: Andy Bell – do you want to finish this?

Comment [AL5]: Date?

13. The WQTAG is concerned that the decision to stop spray irrigation has been made without adequate investigation and discussion with the Rotorua Lakes Water Quality TAG about the potential impacts and risks of the proposed alternatives on stakeholders and initiatives to maintain or improve water quality elsewhere in the catchment, and the background of investigations and debate in the 1980s which came out strongly in support of land disposal.

History

14. 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.

15. 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 subsequently led to stringent consent conditions on the amounts of nutrient (N and P) that the WWTP could discharge.

16. During the 1970s and 1980s the Rotorua City Council (which later became the Rotorua District 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 for technical and cost reasons. 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 from the lake.

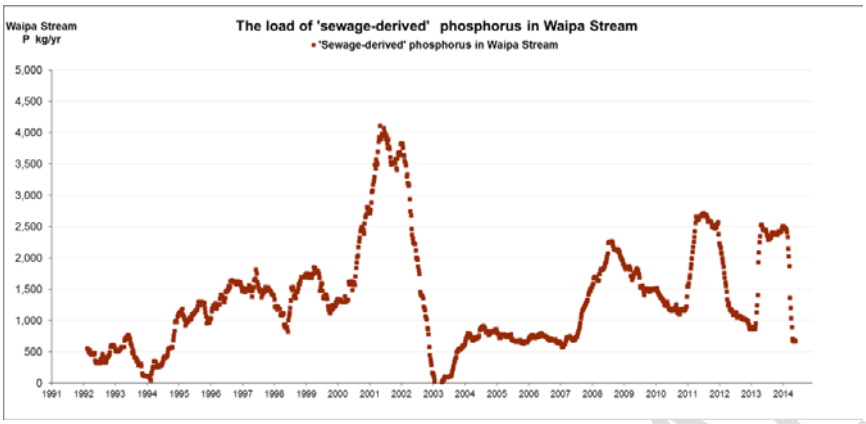
17. The diversion of treated wastewater away from the lake and its discharge into the Kaituna River below Okere Falls was promoted by the National Water & Soil Conservation Authority (NWASCA) as part of the Upper Kaituna Catchment Control Scheme. While this option would have had benefits for Lake Rotorua, 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.

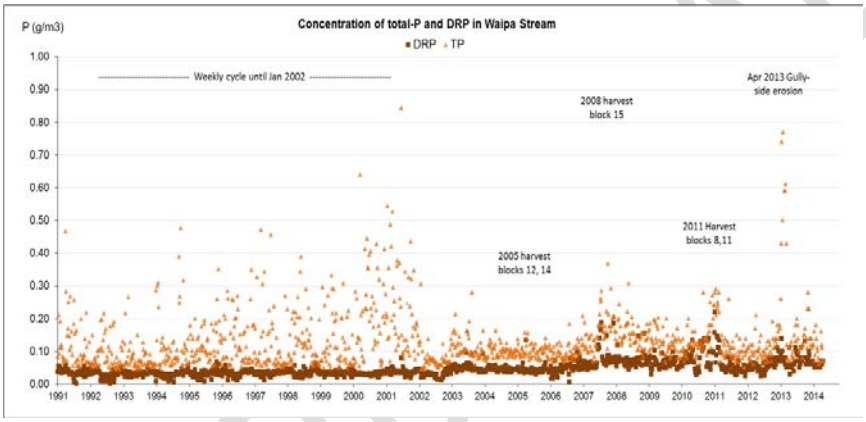
18. The WQTAG understands that the Rotorua ~~Project~~ Sewage Steering Committee (RS~~P~~SC) put forward a motion not to include discharge to the Kaituna River as a potential option for the initial consultation.

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

20. The Rotorua Land Treatment System (RLTS) was commissioned in 1991. Tertiary treated wastewater (using the Bardenpho process) was spray irrigated onto 220 ha of plantation trees in the Whakarewarewa Forest, with the dual aims of reducing the nitrogen and phosphorus loads entering Lake Rotorua to levels that were intended to provide lake water quality acceptable to the community at the time.

21. 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 effluent origin P has been fixed in top 70 cm of soil. 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.





22. The RLTS has generally reduced P loads from sewage well below the consent condition (3 tonnes per year) 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. However, recent modelling indicates a risk of increased P losses from the RLTS. Losses of P have also been observed associated with sediment movement as a result of erosion and harvesting operations coinciding with heavy rainfall events. There is potential for some of the effluent-origin P to be lost as a result of soil erosion following harvesting. Further treatment (TERAX) is currently being considered which is intended to reduce P discharges from the WWTP.

23. Removal of applied N within the RLTS was expected to occur as a result of plant uptake and as a result of 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 and groundwater 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 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 limit. In 2011 N losses from the RLTS of 37.5 tonnes per year exceeded the consented value. More recently the commissioning of the Rotorua MBR plant has enabled the nitrogen loads to be reduced 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.

24. There have been positive and negative effects on the tree crop. Radiata pine productivity has increased by around 20% in upland areas in response to irrigation with effluent, primarily as a result of improved soil N and P fertility. However, foliar diseases were evident on small trees. Excessive tree mortality of Douglas-fir occurred throughout the LTS, 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.

25. Negative effects of effluent on tree growth and soil P losses can be mitigated 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 significant additional land in conjunction with changes in the crop management regime.

26. The TAG understands other options that RLDC is considering include further upgrades to the wastewater treatment plant including higher levels of phosphorus and nitrogen removal and disinfection, followed by discharge of treated wastewater either into the Puarenga Stream or directly into Lake Rotorua, or to land elsewhere ~~in the catchment~~.

27. The recent consent conditions limit the nutrient load from wastewater to 4 t P (recently increased from 3 t P) and 30 t N per year. The WQTAG understands that incoming loads to the WWTP are approximately 50 t P and 360 t N per year, then to meet current consent conditions the WWTP would need to consistently achieve nutrient removal of around 92%. As population increases and outlying lake communities are connected to the Rotroua sewage system, so will the required nutrient removal.

28. Currently 40 t N per year leaves the WWTP and evidence at recent consent hearings indicates that nitrogen removal at the WWTP is close to maximum achievable. A discharge of 40 t N per year to the lake while maintaining the target load of 435 t N per year would require an additional 10 t N per year reduction from other sources.

29. BoPRC is currently seeking to reduce nitrogen inputs from the catchment by 270 t per year through controls and incentives on catchment land use. Unless additional waste water treatment is implemented that reduces the total N discharge to 30 t per year then additional N will need to be found in other parts of the catchment in order to meet the target of 435 t N per year.

30. The total catchment target of 435 t N is a key goal to ensure that long term lake water quality meets the Land and Water plan TLI of 4.2. ~~The TAG would be concerned if another land treatment option or a tertiary treatment option were to increase the load of nutrients to the lake, or if it were to increase the risk of an increase.~~

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 address catchment nutrient loads reaching Lake Rotorua in its history.

b. The WQTAG acknowledges that there ~~would be~~is a significant cost associated with either continuing the current or a new land treatment system, but recommends that any alternative should not increase the ~~believes that it would be difficult to justify an alternative to land treatment if there was a~~ risk of increasing the load of nutrients to the lake.

c. The current ~~l~~land disposal system has been effective in meeting phosphorus load targets for Lake Rotorua. Soils in the RLTS effectively trap phosphorus and could

Comment [KR6]: I thought the new consent imposed a limit on the N load leaving the WWTP (viz., on the amount of N aaplied to the RLTS). Is there also a limit on the N load leaving the RLTS - as there used to be?.

Comment [AB7]: The consent limits P loads from the LT area and N loads going to the LT area. This needs to reflect that.

Comment [KR8]: There are several slightly different figures flying around for inflow loads (some are listed in the appendix) so the TAG needs to confident it has the right figures in these calculations. I suspect that at the high level of removal required (92% based on Alison's inflow of 360 tN/y inflow and 93% based on Chris McBide's inflow of 434 tN/y - see appendix) a difference of even 1% removal affects the risk of non-compliance. I dont know which inflow numbers are correct. Also nothing has been said about future increases in inflow and the implications for % removal

Comment [Anon9]: But 1-2 recent dry years have the 30 t/y target being met.

Comment [AL10]: The treatment process is very different now already with much less risk, and after the addition of filtration even less risk. Dave can you comment whether there is contingency in the CNI agreement that would allow continuation of the LTS if we needed more time to optimise the process after the upgrade if an upgrade option was selected?

Comment [Anon11]: If my statement were adopted from above, then this is largely superfluous:
"Equal or better performance to proposed land discharge options in terms of loads of phosphorus and nitrogen to Lake Rotorua"

Comment [AB12]: Yes I agree with this comment, The WQTAG should not be interested in the options or source as long as the 435 target is met one way or other. Do we support the 435 tN target or not? If yes then delete this paragraph and state" The total catchment target of 435 t N is a key goal to ensure that long term lake water quality meets the Land and Water plan TLI of 4.2.

Comment [AB13]: Why would we care if it is difficult to justify, we only care about WQ and nutrient loads?

continue to do so notwithstanding the need for erosion control during forest harvesting.

d. For the options involving discharge to water, lake targets for phosphorus can only be met if there are significant increases in phosphorus removal at the WWTP. Any increase in P reaching the lake as a result of a new disposal option places meeting the long term TLI at considerable risk and the WQTAG recommends no increase in P as a result of any new disposal option. ~~The risks that phosphorus inputs from wastewater will adversely affect lake water quality are lower for options involving land treatment than for options involving discharge to water.~~

e. The ~~L~~land disposal system has not been as effective in removing nitrogen as was expected. In order to play its part in meeting lake targets, the WWTP will need to achieve very high nitrogen removal efficiencies but nutrient removal is understood to already be at the upper limit of what is achievable. The WQTAG recommends that any increase in N above 30 t per year as a result of a new disposal option must be off-set elsewhere in the catchment to ensure the target catchment load of less than 435 t N is achieved. ~~There are risks of exceedance that have the potential to exceed the risk of exceedance associated with land treatment, depending on the alternative option selected.~~

f. Land use intensification has resulted in nitrogen inputs to Lake Rotorua from land increasing since the RLTS was commissioned. ~~,~~A ~~a~~lum dosing has reduced phosphorus inputs from the Utuhina and Puarenga Streams in recent years, and as a result Lake Rotorua may have moved from being ~~consistently~~ regularly nitrogen limited in the 1970-1980s towards being phosphorus limited.

g. ~~RDC~~BOPRC has set a target for the total nitrogen input to Lake Rotorua of 435 tonnes per year, and ~~has introduced rules~~is introducing planning instruments aimed at reducing nitrogen inputs from ~~farm~~ land use by 270 tonnes per year. If nitrogen inputs from wastewater were in increase then, to reach the target, further reductions from ~~farm~~ other land would be required ~~which could prove to be difficult to achieve both politically and practically.~~to meet this target.

~~h. Options to remedy or mitigate problems occurring in the RLTS have not been fully explored with the TAG, and further discussion is desirable.~~

~~It is unclear to the TAG whether discharge to water in Lake Rotorua or the Puarenga Stream is likely to be opposed by local hapu on cultural grounds.~~

Sources consulted

P.N.Beets. 2014. Statement of evidence. Application to change conditions of consent No 60739.

P.N. Beets, G. Gielen, G.R. Oliver, S.H. Pearce, J. D. Graham. 2013. Determination of the level of soil N and P storage and soil health at the Rotorua Land Treatment site. Scion Report No. 50659.

P.N. Beets, G.R. Oliver, S.H. Pearce. 2014. Assessment of the effects of effluent application on the growth and health of radiata pine and the long term effects on the soil in Whakarewarewa forest. Scion Report No. 53367.

K.D.Hamill. 2014. Statement of evidence. Application to change conditions of consent No 60739.

A. Lowe. 2014. Statement of evidence. Application to change conditions of consent No 60739.

Comment [AB14]: What evidence do we have of this? I think we are missing the real key point here. "Any increase in P reaching the lake as a result of a new disposal option places meeting the long term TLI at considerable risk and the WQTAG recommends no increase in P as a result of any new disposal option"

Comment [CM15]: Re-word. It would be useful for the TAG to have access to the Mott McDonald report which addreses treatment efficiencies.

Comment [AB16]: We are a technical group, we need to keep out of the political arena.

Comment [AB17]:

Comment [AB18]: Do we really want to go here now? We have challenged RLC, the agreement is signed, and the ink is dry. I don't see any constructive reason to go here now.

Comment [AL19]: It's difficult – there will be people in opposition to any option, including land treatment.

Comment [CM20]: This is a very important point, given the RRSSC experience

Comment [AB21]: I have deleted this one. That is not within our area of expertise and we will never be consulted on it so leave alone.

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