

Memo: Urgent science advice required for new Rotorua nitrogen rules



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Summary

Urgent science advice is needed to underpin new nitrogen rules being developed for the Lake Rotorua catchment. This advice must be based on the best available data and clearly show:

- All status quo catchment N losses with calculated attenuation between the land and the lake
 - Anticipated 2022 and 2032 catchment N losses with specific attention to the non-attenuated pastoral N losses
 - If and how the proposed NDA rules and other measures (as identified in the Lakes Programme and Integrated Framework) will reduce N loads from the status quo to the 2022 and 2032 catchment N “load to lake” levels.
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Lake Rotorua catchment science background

ROTAN 2011 report

BOPRC commissioned NIWA to develop the ROTAN model to understand historic, current and potential future nitrogen (N) loads to Lake Rotorua. The key reports produced are the 2009 calibration report and the 2011 final report¹, available online [here](#). Key 2011 ROTAN outputs were:

- Model calibration of all sub-catchments against historic/recent measured stream N concentration and flow rates
- Datasets of daily/annual lake N inputs for status quo and alternative land use change scenarios, with the latter having reductions (from a 2010 status quo) of 250, 300 and 350 tN/y.
- An estimated 35 year response time between catchment land use change and reduced lake N loads
- An estimated groundwater catchment size of 46,377 ha (excluding lake surface).

Further 2011 ROTAN data and results have crucially informed policy development on the “Integrated Framework” and N allocation, notably:

- 2010 land use areas (Table 2), based on multiple sources including BOPRC GIS
- 2010 N loss rates or “yields” (Table 5), including “single value” dairy and drystock pastoral losses based on version 5.4 of Overseer
- 2010 total N exports to the lake for each land use sector (Table 6) – these sum to the 755 tN/y “steady state load” if 2010 land uses are held constant, including point sources and rainfall
- Almost nil attenuation between the pastoral root zone losses and the measured stream N loads at the lake.

¹ Rutherford K, Palliser C and Wadhwa S, 2011: Predictions of nitrogen loads to Lake Rotorua using the ROTAN model.

Developments since 2011

Since publication of the 2011 ROTAN report, ongoing data collection and science development have given different information (compared with ROTAN equivalents) on the following:

- Sector areas and sector N losses, plus individual property (and block) N losses, all varying according to farm management, soils and rainfall - all generated via Rule 11 benchmarking for 2001-2004
- Increased N loss from Overseer version 5.4 to 6.1.3, averaging ~50% (plus individual farm/sector variability, implying significant attenuation is likely, as initially expected by the ROTAN authors
- A smaller groundwater catchment of 45,721 ha (excluding lake surface) based on GNS's June 2014 report
- Several land use changes, both dairy to drystock/cropping and drystock to dairy

While there have been additional ongoing stream N and flow measurements as part of regular BOPRC monitoring, BOPRC's 2013 report² was consistent with ROTAN data. **The key changes since 2011 therefore relate to improved understanding of sector N loss rates, sector areas and attenuation rates.**

Relevance to new nitrogen rules

The new nitrogen rules depend on the catchment N science analysis and N budgets for:

- The overall catchment load at both the root-zone (as estimated by Overseer) and lake load
- The reduction target and its split according to the Integrated Framework, all in relation to meeting the 435 tN/y 2032 sustainable load defined in the RPS, plus the "70% by 2022" interim RPS target.
- NDA allocation between and within the dairy and drystock sectors

To date, there has not been robust independent scientific advice that reconciles the differences between ROTAN and information collated/generated since 2011 and shows how the Integrated Framework fits within a total catchment N budget. This science advice is now urgent because new N rules and NDA levels are due to be formally notified in August 2015.

Science advice required

The science advice requirements for the pending regional plan change were discussed at a "draft rule" meeting on 24 March 2015. Present were: Rob van Voorthuysen, Alastair McCormick, Elva Conroy, Lisa Power and Simon Park. The following science advice requirements were broadly identified and have been refined in this memo, as follows:

1. A status quo annual catchment nitrogen budget

The status quo N budget needs to be based on mid-2001 to mid-2004³ Rule 11 benchmark data (in Overseer 6.1.3⁴) as far as possible and should account for:

- a) The groundwater catchment defined by the "best estimate" from GNS's 2014 report, noting this will require extrapolation to cover non-benchmarked land uses and N loss rates⁵

² Scholes P, 2013: Trends and state of nutrients in Lake Rotorua streams 2013, online [here](#)

³ Although ROTAN used 2010 as the "current" base year, policy development through StAG has clearly identified that the legally defined 2001-2004 benchmarked period is the best "start point" from which N reductions should be made towards 2032.

⁴ It is presumed that this analysis can be carried out using Overseer 6.1.3 data. Given the pending 30 April 2015 release of version 6.2, it would be prudent to check at least a sample of benchmark files to test for differences between versions.

⁵ Presumably based on the "Rule 11 combo" database developed by Alastair McCormick and other staff.

- b) All diffuse and point source N discharges to land and water, with a land use sector breakdown using 2001-2004 data, including a dairy and drystock split (with land use definitions consistent with the draft rules⁶)
- c) N attenuation rates between various discharges and the lake
- d) Attenuated N discharge to the lake, with a source/sector breakdown.

2. A proposed 2032 annual catchment nitrogen budget

The 2032 N budget will be set out in a similar fashion to the status quo N budget and will need to show:

- a) All attenuated diffuse and point source N discharges, using 2001-2004 land use areas, identifying:
 - i. N loads from all non-pastoral sources, incorporating reductions from gorse and engineering interventions based on the latest available estimates provided by the Lakes Programme
 - ii. A target level of attenuated N discharge (to the lake) from land that was in pastoral use⁷ during 2001-2004. This target level will be based on requiring the total annual load from all sources to sum to 435 tN/yr
- b) The non-attenuated discharge from land that was in pastoral use during 2001-2004, corresponding to the attenuated load in 2(a)ii.
- c) A table focusing on land in pastoral use during 2001-2004, comparing:
 - i. the attenuated N loads to the lake in 1(d) (i.e. status quo) and 2(a) (i.e. 2032) with
 - ii. the attenuated⁸ combined pastoral loads used in developing the Integrated Framework, namely status quo of 526 tN/yr, a reduction of 240 tN/yr and a target of 286 tN/yr.
- d) A table showing the proposed NDA levels (to be provided by BOPRC) applied to dairy and drystock land (based on 2001-2004 land use) to give non-attenuated sectoral N discharges.

Please note that it is not a “science advice” matter to align proposed NDAs with the 2032 target pastoral sector N discharge to land. However, it is logical that BOPRC endeavours to create this alignment by appropriate selection of NDAs, having regard to the Integrated Framework.

3. A proposed 2022 annual catchment nitrogen budget

The RPS specifies that N loads to the lake should reduce from an assumed current level of 746 tN/yr to 435 i.e. reduce by 311 tN/yr. Also, 70% of this should be achieved by 2022. Taking these figures at face value, the 2022 target N load is $746 - (70\% \times 311) = 528.3$ tN/yr.

The Integrated Framework used the ROTAN 755 tN/yr status quo N load (not 746) to give an overall reduction of 320 tN/yr, incorporating a rules-driven reduction of 140 tN/yr. It also assumed that by 2022, the following reductions will have been completed (measured as in-lake N reductions): Engineering (50 tN/yr); Incentives (100 tN/yr); Gorse (30 tN/yr), giving a combined 180 tN/yr. This implies that to meet the 2022 “70%” target, the rules reduction by 2022 is 44 tN/yr.

However, all these assumed 2022 reduction amounts need to be revisited to be consistent with the science approach outlined above for the status quo and 2032 catchment N budgets.

A 2022 N budget needs to show:

⁶ This includes limiting “dairy” to the milking platform only, with all other pastoral land defined as “dry stock”, including dairy support. Cropping is mainly fodder cropping and attributed to the associated pastoral use.

⁷ Given the ongoing N allocation debate, it will not be possible to split out “2032” dairy and drystock. Further, there will be an unknown level of land use change by 2032. However, it will be sufficient to determine the aggregate 2032 N load from land that was in pastoral use during 2001-2004.

⁸ It was assumed during the development of the Integrated Frameworks there was very little attenuation and effectively it was ignored. However, the Integrated Framework loads were explicitly “loads to the lake”.

- a) Expected 2022 in-lake loads using the latest estimates for gorse and engineering projects, as per 2(b)i above.
- b) A calculation of the attenuated and non-attenuated N load from pastoral sources (using 2001-2004 land use areas) that will be required to achieve 70% of the 311 tN/yr reduction anticipated by the RPS.

4. Format and subsequent use of the required science advice

The science advice will be a report that will:

- Form part of the s32 report for the notified plan change
- Be referenced by staff in their officer s42A reports
- Form the basis for expert evidence by the report author(s) to be given before the plan change Hearings Panel and any subsequent appeals to the Environment Court
- Enable catchment nitrogen budget tables for status quo, 2022 and 2032 to be copied directly into the proposed plan change document.

5. Related science advice on potentially adjusting targets in response to future Overseer version changes

Council will require science advice on a consistent methodology to amend N targets with Overseer version changes. This issue has not been addressed in this memo but will need to be tackled urgently as it may require a policy and/or method in the proposed plan change. However, such a question is likely to draw on a different (or additional) skill science skill set from the catchment process/modelling expertise envisaged for the catchment N budget advice described above.

ROTAN Implications

It appears likely that the ROTAN model will need to be used to at least revise the status quo catchment N budget, using 2001-2004 data and other more recent information (e.g. revised Tikitere N data). This is expected to produce a robust catchment attenuation factor.

Whether ROTAN should also be used to assess the 2022 and 2032 N budgets, or whether a simpler spreadsheet approach using the attenuation factor is satisfactory, will need to be discussed with the chosen science advisor.