

# MEMORANDUM



**To:** TAG Members

**From:** Andy Bruere  
Lakes Operations Manager

**Date:** 6 September 2012

**File Ref:**

**Copy To:**

**Subject:** Water Quality Technical Advisory Group meeting notes, 6 September 2012,  
Bay of Plenty Regional Council office, Rotorua

---

Those in attendance Del Raurino, David Hamilton, John McIntosh, Dennis Özkundakci, Warwick Silvester, Chris Palliser, Piet Verburg, Paul Scholes, Max Gibbs, Peter Dine, Andy Bruere, Clive Howard-Williams, Alison Lowe, Janine Barber, Mark Buckley, Abigail Lovett.

Apologies from Paul White and Kit Rutherford.

## 1 **Presentation**

The first item on the agenda was a presentation on the 2011/2012 TLIs for the Rotorua Lakes. The most notable point here is that Lake Rotorua was at a TLI of 4.08 and so within the target TLI for the Water and Land Plan (on an annual basis only, Plan is based on three year average). Lake Ōkaro has gone back to a TLI of 5.5. Other details are contained in the presentation attached.

It was raised by Warwick Silvester that the error bars seem to indicate that for long periods of reporting, there is no change in TLI. It was discussed that the error bars shown on the graph were not a true indication of the error in the data but represent seasonal variation.

Pete Verburg also raised that greater accuracy could be obtained by calculating TLI values monthly and then averaging yearly.

### **Action:**

- **Paul agreed to check the TLI result using individual data and check that the equations used are consistent with the national context.**
- **Also Paul agreed to check the error bars information and see if correct error bars can be applied to the graph.**

Some summary points from Paul's presentation were:

- Lake Rotomā had the highest total phosphorus last year that has been recorded, but the lowest total nitrogen.
- Tarawera had an increase in TLI and has the highest TP that has been recorded.

- Lake Ōkātina has the highest total phosphorus recorded for that lake.
- Ōkaro has an increase in TLI to 5.5.
- Tikitapu had an increase in TLI and an increase in total phosphorus and nitrogen.

Chris Palliser asked how the TLI values were set. John McIntosh explained that they were set on water quality experienced in about 1994 for most of the lakes except for Lake Rotorua which was set at a water quality of the 1960s. Lake Ōkaro was also just set as an achievable TLI value of 5.

Peter Dine made the comment that Lake Rotomahana was now overflowing to Lake Tarawera.

**Action:**

- **Peter Dine to pass this information on to Bay of Plenty Regional Council engineers.**

There was some concern regarding the gradient between Rotomahana and Tarawera and potential erosion of the watercourse between the two lakes as well as the direction of water from the connection and impact on water quality from Rotomahana to Tarawera.

## 2 **Matters arising**

### 2(a) **Lake Tikitapu thermistor chain**

Max presented results of the thermistor chain for a 10-day period in Lake Tikitapu. He reported that there was no evidence of major hot-water events due to hydrothermal activity and that the sediment disturbance reported by Chris Hendy of UoW was probably due to gas ebullition from the sediments. Paul Scholes also said he had checked water conductivity results and found no evidence of any indication of hydrothermal events. It was discussed that the Lake SPI value changed through 2005/2006 possibly due to burying of weed beds. Max also presented results on HVOD, i.e., sediment oxygen demand. These results showed that it has dropped since 2005, which was most likely due to burial of organic matter with inorganic sediments dispersed by the gas ebullition events.

Paul Scholes also stated that the Regional Council had started undertaking silica analysis but only one result had been undertaken since the last tag meeting. In future this will be monthly monitoring and give better indication of silica concentrations in the water column. Peter Dine also commented that they had done some testing of stormwater from road runoff.

**Action:**

- **Peter Dine to send stormwater runoff monitoring information from Tikitapu to Bay of Plenty Regional Council.**
- **Andy Bruere and Peter Dine to discuss possible treatment options of road stormwater.**

David commented on sediment acoustic profiling work which was going to be done for Lake Tikitapu. Dirk Immenga from the University of Waikato is preparing to do sediment profiling work and also possibly scan the macrophyte beds around the Lake. This will be reported to the next TAG Group.

## 2(b) The Rotoehu and Lake Hayes Project - NIWA

Max gave an update on the Rotoehu and Lake Hayes project. This is a continuation of the mesocosm testing programme where the three sediment capping agents (alum, aqual P and allophane) are being tested in the two lakes. The work has already been undertaken for two seasons. The project is being extended as some treatments showed a breakthrough of phosphorus in the last samples. Max would like to repeat the trials in Lake Rotoehu (mesocosm trials). He would re-run them at twice the dose rate and repeat the low rate. He was aiming for undertaking this experiment in February 2013.

### Action:

- **Max to send project information through to Andy so that consent process could be started.**
- **Andy to assist with consent application for project.**

## 2(c) Lake Ōkaro wetland

Clive Howard Williams reported that NIWA had inflow and outflow monitoring information which they had used to prepare a recent report on Ōkaro wetland performance. The comments to Clive from Chris Tanner, who is undertaking the work, were that it was a very challenging data set to analyse due to variations in inflow. The summary was that there was reductions in total nitrogen, total phosphorus and sediment but no reductions in nitrate.

### Action:

- **Clive is to circulate the report. The report will be available for discussion at the next TAG meeting if the Group requires.**

## 3 Sediment Technical Advisory Group update

- 3(a) A de-stratification project update was provided by Andy. Two machines had been installed in the Lake during July and August. These are now operating however Hans Burggraaf is working on ironing out some of the teething problems and balancing the machines up to get airflow through each tube.

The next part of the project is physical monitoring required to determine performance of the machine in shifting water. It was suggested that this work should start in about October in advance of Hiroshi Yajima arriving in New Zealand about mid-November. Hiroshi will be using this information to assist in upgrading the code in the model.

Max commented that NIWA has ADCP meters available during October. But these would be used for other projects later in the year. Paul Scholes also indicated that the Regional Council has two CTDs that can help with profiling. Max also commented that NIWA in Christchurch has a remote control aircraft which is useful for photography of these types of events.

- 3(a)(i) David commented that the buoy that has been built for Rerewhakaaitu will be installed in Rotoehu soon to assist with the monitoring of this project.
- 3(a)(ii) Deniz updated the Group on ecological and sediment sampling. The sampling was well underway and he is awaiting the next Sediment TAG meeting to make sure that all components of the monitoring are coordinated.

- 3(a)(iii) Andy provided an update on koura monitoring within the Lake. He identified where the tau lines had been placed and that this monitoring had been started in 2011 in advance of this project to identify any negative or positive impacts on koura within the Lake.

3(b) **Lake Ōkaro**

John McIntosh commented that recent phosphorus levels increasing in Lake Ōkaro and had suggested an alum application to address this. He also commented that use of alum was to gain experience in its application. Two applications were made in the last two months, six tonnes applied during July and 15 tonnes applied during August. During the second application John commented that there was some difficulty in mixing the soda ash and so the second application had only minimal soda ash added. During the application of course the pH was checked and was maintained at greater than 6 throughout the process.

David Hamilton then presented information on Ōkaro monitoring results over the period 2003/2012. He showed trends in algae, nitrogen and phosphorus. He made the point that we have achieved a reduction in total phosphorus and DRP but now they are starting to increase.

He then went on to discuss the effect of the December 2011 aqual-P application. He commented that he believes the aqual-P application probably flocculated sediment and phosphorus-containing material but possibly not buoyant cyanobacteria. This would have provided better light conditions and so there was an increase in cyanobacteria soon after the application.

David discussed whether he should complete the December aqual-P report as an individual report or incorporate it with the winter alum dose just completed. It was agreed that the results of both application be incorporated into one report.

Andy raised concern that the lake TLI is up at 5.5 after a significant amount of work has been done on this Lake. We're not sure whether the lake will have gone to a higher TLI if these actions had not been undertaken, however we have not permanently achieved a goal of remaining below a TLI of 5.0. It was discussed that although we have resource consent to apply alum each year, the Action Plan does not have any actions in it suggesting application of alum and so it seemed appropriate to go back to the community and to the Council with the results of the work we have already done and get some preference on the next steps with respect to continuing the restoration process. The main options are:

- 1 Wait for a period of time and assess whether the lake is improving due to the actions already undertaken.
- 2 Continue alum dosing to reduce phosphorus levels.
- 3 Reassess catchment nutrient loads and decide whether these loads should be reduced.

It was decided a possible way forward would be as follows:

- Analyse aqual-P application for 16 December and the alum for July and August 2012.
- Assess information on the impact of the wetland.
- Assess impact of other actions including detention bunds which are yet to be completed and effect of pine trees planted.
- Run information in the Lake model looking at the actions over a ten year period.

|

**Action:**

- **Deniz to re-run the lake model and take into account the changes as listed above. The aim would be to run it over an extended period – ten years – so that we can get a better understanding of whether the actions will have any long term benefits.**
- **David to report on both recent applications of aqual-P and alum in one report.**

Some other comments that were made were by Max where he discussed a paper on the effects of cyanobacteria on sediment fluxes. He said it was possible that cyanobacteria were producing alkaline conditions and causing possible dissolution of P from lake edge sediments which could increase P levels. This could be applicable to Lake Ōkaro and the higher P levels in Ōkaro. He also pointed out the risk of applying alum during high pH conditions causing a release of phosphorus and  $Al^{3+}$  ions as well as ammonia release which could be toxic.

John McIntosh outlined that the dose of alum applied in winter was greater than the aluminium equivalent of the 2009 aqual-P application. The 2009 aqual-P application was very successful in that it prevented an algal bloom in the following year and so it is possible that this recent application could have a significant benefit to phosphorus and algal conditions.

Peter Dine just mentioned that the Hannahs Bay wetland provides a continuous flow and wondered whether it was worth monitoring that.

**Action:**

- **Pass on to John Paterson a request to see if we can get a student to monitor this wetland over the near future. Include Paul Scholes to check where the site was that is part of the regional monitoring network and assist in selecting monitoring sites.**

**3(c) Rotoiti consent**

Andy outlined that we now have resource consent to apply alum and aqual-P in Okawa Bay of Lake Rotoiti. This came about as a result of the 2011 algal bloom in Okawa Bay. In 2011 an emergency application of aqual-P was made in the Bay. To address the situation in the future we now have a resource consent which allows us to put 5 tonnes of alum or aqual-P into the Bay as a result of algae monitoring showing initiation of a bloom.

**3(d) Rotorua inflow model**

David Hamilton presented information on this. He commented that Jonathan Abell was close to finishing his PhD. He's be looking at storm flows and bio-availability of nutrients. He was investigating what happens when the lake becomes anoxic and whether these nutrients from storm flows become bio-available.

He was also investigating inflow compared with circulation in the lake. He had identified that where the nutrients or sediment go is dependent on lake circulation, and surprisingly some currents keep the sediment closer to the shoreline and deposit it in shallow waters.

He has also done bio-assays to look at nitrogen and phosphorus limitation. Generally there tends to be substantial nutrient limitation at the lake centre but the edges of the lake near the inflow are mostly not limited by nutrient availability at all.

David also talked about Puarenga and the work involving the application of SWAT to the catchment. There was substantial data from Rotorua District Council with which to assist in its calibration. Some interesting features are starting to emerge including lower suspended sediment loads when the effluent irrigation frequency was altered.

**Action:**

- **Jonathan Abell to present the results of his PhD to the next TAG meeting.**

**4 Modelling progress****4(a) Tikitapu**

David made a comment that diatoms are mostly absent within Lake Tikitapu and it is mostly only chlorophytes. The DYRESM:CAEDYM model has been applied. Some comments from the presentation were:

- Anoxia in the bottom waters persists in the summer.
- A DCM is present in the Lake between about 15-23 metres. This sits just immediately on-top of the anoxic layer.
- Its water is like a glacial lake in terms of fine sediment particles reinforcing the blue colour of the water by enhancing light scattering.
- They modelled the removal of septic tanks and got a possible increase in water quality. This will be elaborated upon in the modelling report.

David also mentioned benthic production from cyanobacterial mats will be built into future modelling of this lake based on NIWA field surveys. The mats lie at about 4 to 12 metres depth.

**4(b) Lake Rerewhakaaitu**

Deniz reported that he's close to completing the modelling on this but there is more work to be done before he can make any conclusions. He commented he is still calibrating the model. He's worked on three phytoplankton groups. His comment is the Lake was quite difficult to calibrate. Has looked back 20 years, there is an increase in nitrate concentrations in inflows which is a concern. This seems to correlate with increase in chlorophyll in the lake. Nitrate levels about 5 to 6 grams per cubic metre nitrate-N have been recorded in the Mangakino Stream.

He also commented the catchment size from back calculation of nutrient loads was quite small with a surface water catchment of about 5 square kilometres.

**Action:**

- **Present results of Rerewhakaaitu lake modelling at next TAG meeting.**

**4(c) Lake Rotorua**

David pointed out that they had gone to significant effort along with Simon Park to check the land use P inputs. However there was no significant change to the inputs decided last year and so unfortunately this has delayed the project.

He's checking the alum effect and weather pattern and will be able to report on that soon. However it appears that recent poor summer weather and alum dosing have been the likely cause of rapid improvement in water quality for Lake Rotorua.

He reported that we still need to get a reduction of nitrogen of about 350 tonnes.



At this stage John Patterson provided some information on the phosphorus reduction project for Lake Rotorua. It comprises establishing detainment bunds to trap sediment during storm flows and reduce the peak of the hydrograph reaching streams and the lake during storm events.

John commented that from the research work there is probably about 12 tonnes of phosphorus coming into Lake Rotorua which could be targeted during storm flows.

So far five structures have been constructed with good farmer buy-in. They are validating the performance of these structures. If these prove successful then we would need to build hundreds of these structures within the catchment to have major impact. The study also includes investigation of an old detainment bund. They have analysed the soil through a cross-section of the ponded area and it shows an increase in phosphorus concentrations about three times as you progress towards the bund.

He also stated that a longer detention period was preferable but some of the bunded areas are on the farmers' lower gradient land so they tend to not want to inundate those areas for more than about two or three days.

## 5 Groundwater investigations in the wider Tarawera Catchment

Janine Barber and Abigail Lovett from GNS presented a comprehensive report on groundwater investigations within the catchment, this is summarised into a PowerPoint as attached. The groundwater work has been split into three phases and Janine explained we were now into phase three of the programme, investigating groundwater around Rotokakahi, Tikitapu and Lake Ōkātika. Some summary points are as follows:

- Three wells were installed for this phase. The fourth well was not installed because we couldn't get access to the land adjacent to Rotokakahi.
- Rotokakahi well No.8 water level is about 9 metres below ground level with  $\text{NO}_3\text{-N}$  levels of  $2\text{g/m}^3$  typical of sheep and beef land use leaching, c.f. Mangakino stream with  $5\text{g/m}^3$   $\text{NO}_3\text{-N}$  typical of dairy land use leaching. Nitrate levels coming from the surrounding farmland.
- Tikitapu bore is located in a recreation reserve adjacent to the water-ski area and boat ramp. Nutrient levels were lower in this bore compared with Rotokakahi and in particular nitrate nitrogen levels were lower.
- The next steps in the programme are for the development of a greater Tarawera Lakes geological model and then following that a groundwater flow model for the greater Tarawera Lakes. Then in year three complete a nutrient model for that same area.
- Next site is to try and get a bore in at Rotokakahi between the lake and the irrigation area as well as some bores along Ōkātika-Rotorua boundary.
- The bores within this programme will be monitored for isotopes on a five yearly basis to continue gathering information on groundwater age.

It was commented that there is a need for estimate of flows to feed into the lake models and this will be available in year two.

## 6 Update on Rotorua sewerage treatment plant (Alison Lowe)

Alison commented that the NBR plant had been completed in March 2012 and was removing nitrogen as expected and there was a small reduction in phosphorus load going to the forest. The land treatment system was receiving about 45 tonnes of nitrogen

however this had reduced to about 34 to 35 tonnes of nitrogen and 1.5 tonnes of phosphorus as a result of reduced rainfall in the last few months.

Alison reported that the district council is looking at a long list of alternative treatments to the existing land disposal system. These will then be considered by council in selecting alternatives to improve performance of nutrients reaching the lake from the system.

Paul Scholes asked about water reductions and were they included in this list of alternatives to improve treatment. Alison said that they would be considered however it was pointed out by Mark Buckley that there were some difficulties in metering water at every domestic take off point due to corrosion and contamination issues around water meters.

## 7 **Update on Rotomā sewerage system (Mark Buckley)**

Mark outlined the sewerage reticulation areas and disposal which was subject of the resource consent application recently to the Environment Court. He explained this hearing was adjourned until September when further information will be submitted. The main reason for this is:

- The Judge instructed there would have be a shift of the disposal area because of a site of cultural significance close to the disposal area.
- Ngāti Māhino were not prepared to accept any waste flowing down from the disposal area into the Waitahanui Catchment.
- A proposal has been brought forward to remove the disposal area into the Rotoehu Catchment.
- This would naturally leach nutrients back towards the Rotoehu Lake.
- The initial site selected was on a fault and it was difficult within the area to find a site which was not too steep for construction.

## 8 **Update on Tarawera sewerage (Mark Buckley)**

He commented that the residential area would be reticulated but not the properties at the landing or the Te Mu subdivision up near the Buried Village. This is because the pipeline leading back to the sewerage treatment plant would be going up the hill to Lake Ōkāreka near the Waitangi Stream and then follow around the Lake to join with the Ōkāreka pipeline.

### **Action:**

- **Andy to convey to Bay of Plenty Regional Council planner undertaking Tarawera Action Plan the area of reticulation and ensure they are aware of the whole residential catchment not being reticulated.**
- **Convey to planners also that there is a Rotomahana overflow and this needs to be taken account of during the Action Plan process.**

## 9 **Rotokakahi update**

- 9(a) Paul White had given his apologies so Andy gave a brief update on the investigations around the Whakarewarewa forest irrigation area and land adjacent to Rotokakahi. Paul White is collating a report on the potential impact of the irrigation area in Rotokakahi. He is being assisted by some hydrology work in the catchment undertaken by John McIntosh. This will be available within the next month and presented to the TAG at our

next meeting. The main objective here is to ensure that forest irrigation water is not flowing back to Rotokakahi and impacting water quality. This project will be assisted in time of bore No.9 and the groundwater investigations can be completed and monitored.

- 9(b) Andy commented on iwi engagement around this project. Its links with general engagement with Tūhourangi and Ngāti Wahiao in that we're trying to set up a workshop for long term engagement to assist with the Action Plan process as well as assist with implementing projects that will help protect and restore the lakes in this area.

## 10 Lake Rotorua alum dosing objective

John McIntosh presented on this stating that it would be helpful for Regional Council to have a guideline to help them decide how to adjust alum dose on the Utuhina and Puarenga plant and the connection with the TLI target. He pointed out that the total phosphorus target for a TLI of 4.2 is about 20 milligrams per cubic metre. He also pointed out that the Regional Council has an alum dose horizon to stop dosing about 2018. It appears now from the monitoring works taking place that Lake Rotorua's benefiting from the alum in the lake and that has probably been significant in reducing the impact of sediment phosphorus releases. John commented that the Regional Council's efforts will shift in the future more towards land use control and turning off nutrients coming to the Lake.

John commented that last summer there was no phosphorus release but there was an ammonia release which indicated that the sediment was probably capped.

Max made the comment that we should be balancing alum with P inputs if the lake bed is capped and we should be reducing alum dosing as land use controls become more effective.

John suggested match inflow Ps with alum using 20 milligrams per cubic metre in the lake as a trigger. Paul reported that currently total phosphorus is down to 15 milligrams per cubic metre. The dose rate has been halved over the last three weeks.

David suggests that we need information on Al in bottom sediments before making decisions.

Clive and Warwick were concerned about turning dosing down too early and suggest keep dosing going for a further year. However, it was clarified that the dosing had not been closed off it had just been reduced to half the dose rate which they were satisfied with.

John also raised the issue around Rotorua having low lake alkalinity. He suggested that it would be advisable to ensure we did not dose unnecessarily as this presented a potential risk.

It was suggested that management should be based on three factors:

- 20 milligrams of phosphorus per cubic metre in the Lake.
- Inflow of phosphorus compared with the ten tonnes per year in the Action Plan.
- Has the sediment been capped which can be calculated from Dennis' sediment sampling.

### Action:

- **Report back at the next meeting, John, Dennis, Paul to look at the three factors above.**

Items 11 and 12 were deferred and will be circulated by email if necessary.

## 13 Other business

Clive pointed out that Piet Verberg had prepared a report on Bay of Plenty Lake Internal Loads. This report was still subject to peer-review and Clive suggested that it be tabled at the next meeting.

### Action:

- **Table NIWA report on Internal Loading of the Lake of the Bay of Plenty at the next TAG meeting.**

Alison Lowe raised concern about the target for nutrient reduction from sewage in the initial restoration paper on Lake Rotorua by Rutherford et al in 1989. It appears that some specific targets for sewerage had been set at that stage and Alison is suggesting that as more sewerage is reticulated to the Rotorua plant and upgrades are made, is that the plant is at its limit of technical design. Also, any improvements in treatment incur an additional marginal cost which may not make it the most effective area to spend money to reduce nutrient to getting into Lake Rotorua. Mark Buckley also pointed out as areas around the lake have been reticulated they have reduced the nutrient load and although it's been treated some of this now needs to be discharged back into the lake.

There was no particular action the TAG Group could take on this matter because it appears to be a political decision as to what activities are targeted through the consenting process, the plan process and the Action Plan process. The TAG Group does not have a particular recommendation on what nutrient contribution should be targeted other than that the sustainable load for the Lake in terms of nitrogen and phosphorus should be met.

It is suggested that the District Council will have to work through their resource consent process with the Regional Council to determine whether the requirements of a sewerage treatment plant can be changed.