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NEWSLETTER OF THE
LAKESWATER QUALITY SOCIETY

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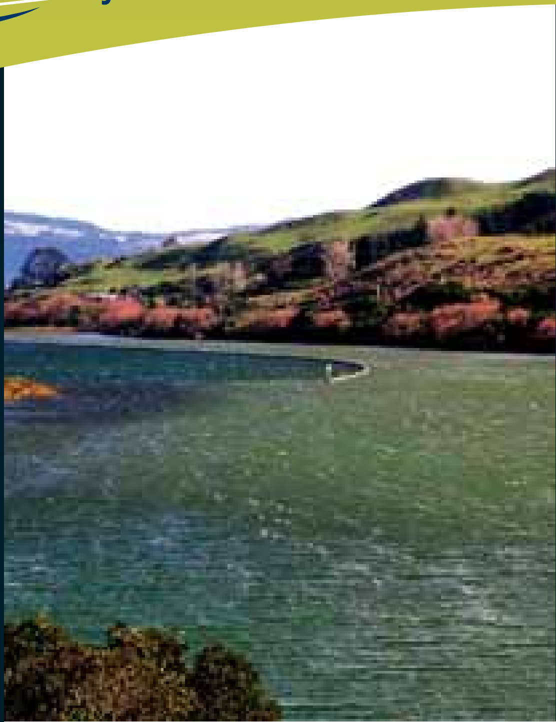
# LakesNews

Lakes WATER QUALITY Society



## this issue



*Acknowledgements :*
*Lakes Rotorua & Rotoiti Action Plan (EBOP), presenters at the Lakeswater Quality Symposium 2008, and other referenced authors or sources.*

## Murky Waters for Okere, Kaituna, and Maketu

The diversion wall is doing its job very well for most of Lake Rotoiti. Water quality is the best it has been for many years and there has been a lot of activity on the lake. However, water quality in the Okere Arm, the Kaituna River and the Maketu Estuary can only be described as disgusting and severely degraded. Adding insult to injury is the rubbish that now drifts down the arm and collects on the beach by the motor camp and along the edges. The wall has meant that all the water from Lake Rotorua, and what it contains, is now going directly down the Okere Arm and into the Kaituna River.

The wall has been a quick fix for Lake Rotoiti but unfortunately the Okere Arm is a reminder that the problem has not gone away. Until the waters of Lake Rotorua are cleaned up, the Okere Arm will continue to suffer.

Money is about to be spent on the waterways of the Kaituna River and Maketu Estuary to improve water quality and restore healthy eco-systems. However, all the time, money, and remedial measures about to be put in place will help little if water flowing down from Lake Rotorua remains as dirty as it is.

Lake Rotorua will not be fixed in our lifetime but we need to ensure that future generations will say that we worked hard to clean it up. (Refer Chairman's Report, page 3)

## Lake Rotorua Still the Monster

Bill Bayfield (CEO, EBOP) highlighted the problem at the 2008 LWQS Symposium. "There are four 'priority lakes' - Rotorua, Rotoehu, Rotoiti, Okareka - agreed in August 2008 for shared funding of defined restoration costs with Central Government …Not all the lakes are equal in terms of water quality, risks, solutions, or the tools required…For three of the priority lakes, the challenges and solutions are very do-able. Not so for Lake Rotorua – it is a Monster". Why is Lake Rotorua so different? There is a large, growing community on the foreshore; there is intensive land use in the catchment, including 26 dairy farms; and the large catchment means lengthy lag times between nutrient loss from the land and its arrival in the lake. **The average age of the water entering the lake is over 60 years - nutrients exported from the back half of the catchment in the 1950's are still yet to reach the lake.**

Good science tells us that 36% of all phosphorus coming into Lake Rotorua is natural via leaching of rock substrate and geothermal activity, that farming contributes another 45%, and urban use, forestry, rain and bush the balance of 19%. For nitrogen the story is more about intensive land use - 75% of all nitrogen comes from farming, with dairying being the largest contributor. To restore the lake we have to remove from the catchment **311 tonnes of nitrogen and 10 tonnes of phosphorus.**

We must address nutrient discharges from land. This huge task can only be achieved by a combination of best farming practice, less intensive farming, more forestry, and the retirement of land perhaps via subdivision incentives. Farmers are implementing, or should be, best practice management to minimize nutrient losses. These can substantially reduce the amount of nutrients lost. If properties are going to be retired from farming or shifted to a less intensive form, compensation will be needed.

**Lakebed sediments also have a major role in the trophic state of the lake.** The recycling of nutrients from sediments is greater when bottom waters become deoxygenated, typically from September to May - via temperature stratification, consequent lack of mixing, and by the decomposition of dead algae which have sunk to the bottom.

**If we are to see an early improvement in Lake Rotorua, lake and stream treatments offer our main hope.** Much has been done to remove phosphorus by flocculation, and the Tikitere geothermal removal will be positive. Prof. Hamilton and his team have a huge challenge to guide the substantial gains needed. The community have agreed that Lake Rotorua will be restored to a TLI of 4.2 - we all aim to see this achieved, even though we know the challenge is a MONSTER.

## Trophic Level Indices (TLI) 2003-2008

exceeds Target TLI

| | | | | | TLI < 2 | Very Poor (Microtrophic) |
|---|---|---|---|---|---|---|
| Lake | 3 yearly average TLI to 2005 | 3 yearly average TLI to 2006 | 3 yearly average TLI to 2007 | 3 yearly average TLI to 2008 | Target TLI | Water Quality at Target TLI |
| Okaro | 5.6 | 5.5 | 5.5 | 5.0 | 5.0 | Very Poor (Supertrophic) |
| Rotorua | 5.0 | 5.0 | 4.9 | 4.2 | 4.2 | Poor (Eutrophic) |
| Rotoehu | 4.6 | 4.5 | 4.6 | 3.9 | 3.9 | Average (Mesotrophic) |
| Rotoiti | 4.5 | 4.3 | 4.1 | 3.5 | 3.5 | Average (Mesotrophic) |
| Rotomahana | 3.8 | 3.9 | 3.9 | 3.9 | 3.9 | Average (Mesotrophic) |
| Rerewhakaaitu | 3.4 | 3.5 | 3.5 | 3.6 | 3.6 | Average (Mesotrophic) |
| Okareka | 3.2 | 3.3 | 3.3 | 3.0 | 3.0 | Average (Mesotrophic) |
| Tikitapu | 3.1 | 3.1 | 3.0 | 3.0 | 2.7 | Average (Mesotrophic) |
| Okataina | 2.9 | 2.9 | 2.8 | 2.8 | 2.6 | Good (Oligotrophic) |
| Tarawera | 2.8 | 2.8 | 2.8 | 2.9 | 2.6 | Good (Oligotrophic) |
| Rotoma | 2.5 | 2.5 | 2.5 | 2.6 | 2.3 | Good (Oligotrophic) |
| Rotokakahi | 3.4 | 3.4 | 3.5 | 3.8 | 3.1 | Good (Oligotrophic) |

## Trophic Level Index (TLI)

The TLI is widely used to measure changes in the nutrient (trophic) status of lakes in New Zealand. This index considers phosphorus and nitrogen levels, as well as visual clarity and algal biomass. Lower is better – very good quality water requires a TLI less than 2.0.

## Nitrogen and Phosphorus

Nitrogen and phosphorus are essential plant nutrients. In large quantities they can encourage the growth of algal blooms. High levels of water-bound nitrogen and phosphorous most often come from farm runoff and urban wastewater, but can also come from geothermal sources and deep springs that leach phosphorus from rock substrates.

## Water Clarity

Clarity is measured using a Secchi disc attached to a tape measure. The depth at which the disc disappears from sight is recorded from the tape measure.

## Chlorophyll a

Chlorophyll a is the green pigment in plants used for photosynthesis. The amount in lakes (can also be assessed by remote imaging) is a good indicator of the total quantity of algae in a lake.

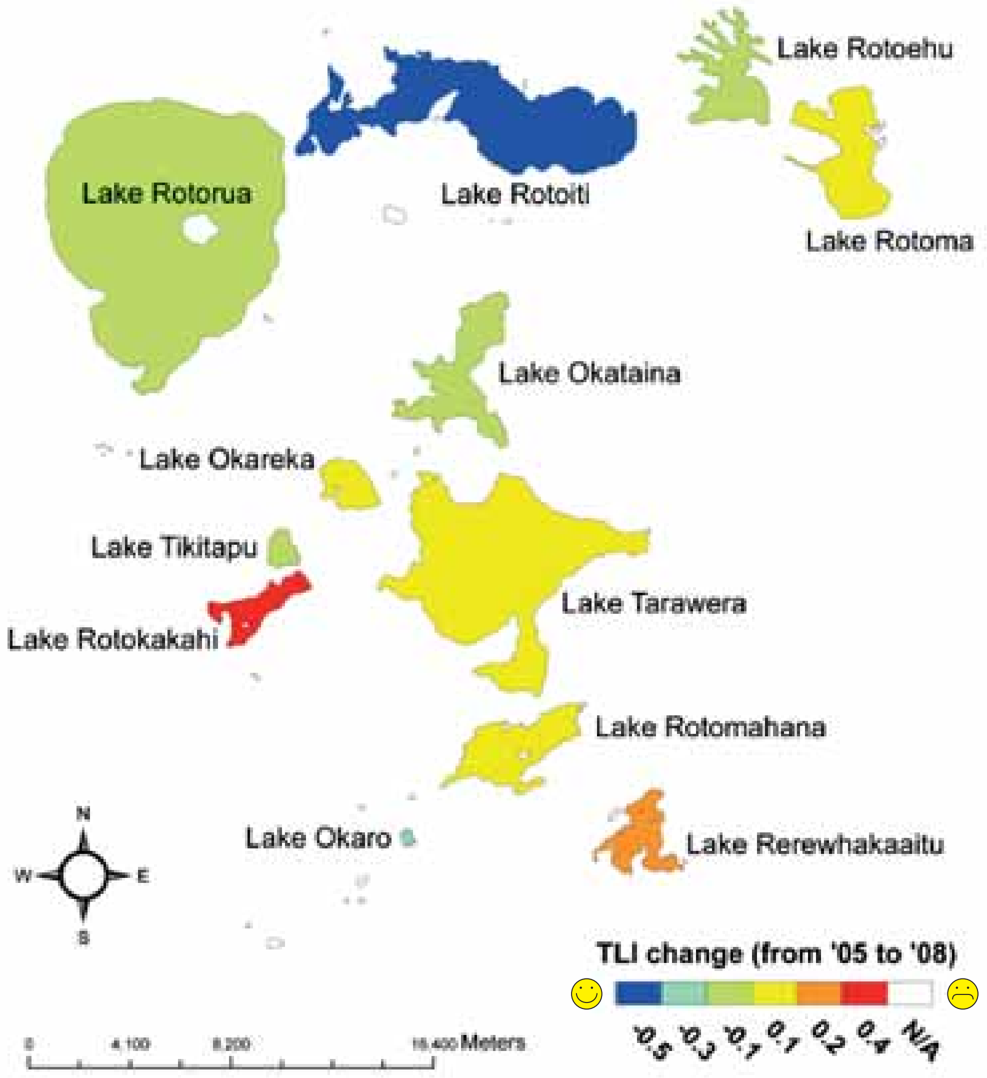
# Blue-Green Algae

Occur more frequently above a certain TLI level. Poor quality waters can experience blue-green algae (cyanobacteria) blooms eg. early Okawa Bay (TLI 5.3), Lake Okaro (TLI 5.7). Lake Rotoehu began to experience algal blooms in 1994 when the quality of the lake deteriorated and the TLI increased from 3.7 to 4.8.

Blue-green algae blooms can also form in lakes with good water quality, like Lake Tarawera. Here a large inflow of water with a low nitrogen to phosphorus ratio enters the lake along the shoreline adjacent to Rotomahana. This favours blue-green algae and when conditions are calm they can assume bloom proportions

## Changes in the Lakes 2005-2008

Kohji Muraoka, Waikato University student



# Perspective from the Chair

John Green

Our society has spent a huge amount of time and effort in addressing the significant deficiencies in the Lake Rotorua and Rotoiti Action Plan which was released to the public in July 2009. As far as Lake Rotoiti is concerned the planned nutrient targets of 130 t/N/yr and 15 t/P/yr have been achieved by the impact of the diversion wall. However the water quality in the Okere arm, Kaituna River and the Maketu estuary has significantly deteriorated due to their high concentrations of contaminated water from Lake Rotorua.

This leads us to **focus on Lake Rotorua** and the plans necessary to clean that lake up as soon as practically possible. We are deeply concerned that the draft Lake Rotorua plan, which was agreed by the Action Plan working party after three years of full community and science deliberations, could resurface in July 2009 (two years later) with such a **significant roll back on nutrient targets**.

Over the last three years we have all been aware of the huge debate over climate change and the need to care for the environment. We expected EBOP to take a tough stance on Lake Rotorua's nutrient targets and, if anything, increase the tonnages and reduce the time to achieve them. We were naturally shocked to see N targets let out 12 years and 200 years respectively, and P targets let out 12 years.

Given that the lake plan is a non-statutory document one would have thought that the community would prefer to see the actions needed to clean up the lake being as detailed and achievable as possible. Otherwise, aren't we burying our heads in the sand? The consequences to the Rotorua district of Lake Rotorua not being cleaned up until 2250, i.e. 240 year's time, do not even bear thinking about.

So come on, Rotorua Te Arawa Lakes Strategy Group, EBOP and RDC, let's see a tough but achievable plan of actions to clean up Lake Rotorua within an acceptable time frame. Ultimately you will be judged less on what you say and more on what you do.

| | From the catchment only | Original Plan June 2007 | Revised Plan July 2009 | Proposed delay with Revised Plan |
|---|---|---|---|---|
| N target | 250 tonnes / year | By 2017 | By 2029 | Delayed 12 yrs |
| | 311 tonnes / year | By 2050 | By 2250 | Delayed 200 yrs |
| P target | 10 tonnes / year | By 2017 | By 2029 | Delayed 12 yrs |

## Rotorua Lakefront

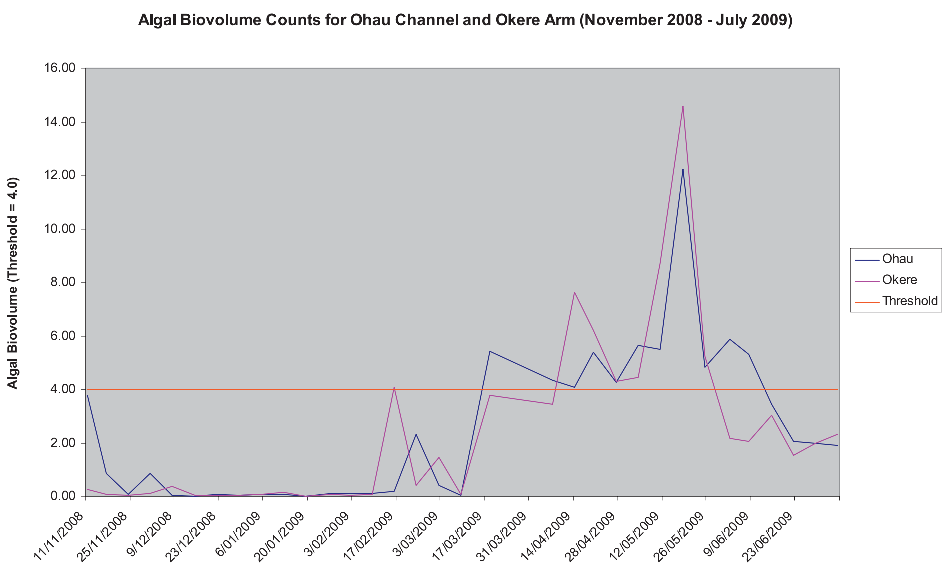
Congratulations to the Rotorua District Council for their initiative in creating plans to bring together the city and the lake front, to take advantage of one of Rotorua's best assets, its beautiful lake. The full plans are on their website www.rdc.govt.nz . LWQS believes that these plans must be linked with the RDC commitment to clean up Lake Rotorua, including the reduction of nutrient flows to the lake. If the lake remains persistently green and murky, as it has been this year , it will not be an attractive sight at the end of the pier. We propose:

- Routine lake water management measures be included in the design plans to accommodate regular weed harvesting along the frontage, to both reduce nutrients in the lake and generally improve the amenity

- That the cleaning of trash from lake water should be as frequent as cleaning the pavements and trash from the streets

- A management plan for the provision of a separate and detached area for tourists to feed the birds. In New Zealand these water birds, such as the black swan, can become a nuisance but are of great interest to tourists

- **Most importantly**, that an area be set aside for a **large swimming beach** to be developed in the future when the lake water quality improves.




## Algae Counts for Ohau Channel and Okere Arm

The LWQS has 'adopted' the weekly biovolume measurements for the Ohau Channel and Okere Arm as useful indicators of the quality of water flowing from Lake Rotorua into the Okere Arm and Kaituna River. From March to June 2009 these measurements were consistently above the safe threshold of 4.0

*Ref : Michael Quintern (EcoVerm), Roku Mihinui and Hera Smith (Te Arawa Lakes Trust).*

## Vermicomposting Lake Weed

There has been significant Lake weed harvesting during 2008/2009 – from Lake Rotoehu alone, 3000 tonnes were harvested (ca. 8 tonne of Nitrogen). A joint project between the Te Arawa Lakes Trust, Fonterra and the Sustainable Farming Fund investigated the composting of lake weeds, pulp mill wastes, and DAF sludge produced during milk processing. A mix of I part lakes weed and 2 parts pulp fibre was, within 7mths, converted to an excellent compost suitable for application to rural land or other uses. Naturally occurring Arsenic concentration in lake weed was reduced to acceptable levels at this mix ratio.

**Note : Please avoid the spread of lake weeds. Lake weeds must not be transported to a vermicomposting location if other lakes or waterways are enroute.**

# Vermicomposting of Lake Weeds, Pulp Wastes, and Milk Processing Wastes

## Results

- Combinations of 1 to 2 parts of carbon rich fibre such as pulpmill solids and 1 part of lake weeds provide an excellent feedstock for compost worms.
- Combination of 4 to 8 parts of carbon rich fibre such as pulpmill solids to 1 part of DAF sludge from milk processing plants provide an excellent feedstock for compost worms.
- Feedstock mixture with DAF sludge takes approximately 2 to 3 months before worms can colonise windrows.
- Increase of carbon source in the feedstock with lake weeds leads to a wider C/N ratio of the vermicompost.
- An application of 20 $m^3$ of vermicompost per ha (equals 2 mm depth) approximately 2 tons of carbon is applied to soil.

**Key Project Objectives**

1. To find out if various industrial and environmental organic wastes could be vermicomposted.
2. To determine the potential of vermicompost to replace and increase organic carbon content in soils.

In New Zealand, large quantities of organic wastes are currently being land filled, even though the New Zealand government has encouraged producers to recycle and utilise these wastes. Pulpmill solids and lake weeds are landfilled in the eastern Bay of Plenty and Dissolved Air Flotation (DAF) sludges from milk processing plants are land applied with high environmental impact. Soils in the eastern Bay of Plenty consist predominately of pumice with very low organic matter content. Recycling organic carbon rich wastes as fertilisers or soil conditioners has the potential to increase soil organic matter and as a result increase natural soil fertility. Successful vermicomposting of these wastes has been reported in scientific papers with trials mainly conducted at a laboratory scale. The aim of this project was to conduct a field trial to determine whether vermicomposting was feasible using local industrial wastes within the local climate. Following analysis of the finished product - vermicompost - local farmers and nurseries were approached to identify potential markets.

**Lake Weeds**

Compost worms colonised the waste within a few days and started breeding rapidly. Vermicomposting was finished after approximately seven months. All worms had disappeared from the windrows after nine months. Lake weeds are able to accumulate heavy metals from the sediment and or lake water according to the geological concentration of the water and sediments. These may vary from lake to lake or even within the lake. It is recommended that the heavy metal concentration within samples of lake weeds be measured, before considering vermicomposting and recycling lake weeds on land. The arsenic concentration of the lake weeds used for the trial was 365 mg/kg. The guidelines for safe application of biosolids to land in New Zealand allow a maximum concentration of 20 mg/kg for Arsenic as Grade A for land application. All other heavy metals measured for in the lake weeds, recorded far below the limits set out in biosolids guideline. The pulpmill solids did not contain high levels of metals and therefore could be land applied. By blending lake weeds with pulpmill solids the arsenic concentration of the finished vermicompost was reduced to a concentration below 1ppm which made the product fit within the limits of Grade A according to the biosolids guidelines.

# Weed and Pest Management – Public Consultation

*Ref. EBOP website* www.envbop.govt.nz/

Environment Bay of Plenty (EBOP) is looking at making changes to the way they work with the community to control weeds and pests. These changes may affect you and the weed and pest and work that you carry out on your property. This is the first stage in preparing a regional pest management strategy.

Key facts:

- Council spends $2.1 million on Biosecurity each year
- Environment Bay of Plenty requires weed and pest control to be undertaken on approximately 4,000 properties every year in the Bay of Plenty
- Management plans are developed for all new incursions of weeds and pests subject to regulation
- Weed and plant pest control is estimated to cost New Zealand over $100 million each year
- New pest plants become established almost weekly in New Zealand

To find out your views and ideas about the future of pest management EBOP is arranging a series of public consultation days (see dates below) across the Bay of Plenty. Everyone is welcome to drop in at anytime during these sessions to talk to staff, gather information and ask questions.

To send your thoughts, register your interest in attending the public meetings, or if you would like further information email : pest.management@envbop.govt.nz

## Consultation days

**Katikati and Tauranga** : Tues 6 October 2009, Katikati Memorial Hall Lounge, 5.30pm - 8.30pm

**Tauranga and Papamoa** : Wed 7 October 2009, Papamoa Recreation Centre, 5.30pm -8.30pm

**Opotiki** : Tues 13 October 2009, Woodlands Hall, 5.30pm - 8.30pm

**Rotorua** : Wed 14 October 2009, Meeting Room, Redwood Forest Visitor Centre, 5.30pm - 8.30pm

**Whakatane and Awakeri**: Thursday 15 October 2009, Awakeri Memorial Hall, 5.30pm - 8.30pm

## Gorse Is a Water Quality Issue

Gorse is an invasive and Nitrogen-fixing weed, and has infested approx. 900,000ha or 3.3% of New Zealand's total land area. Within the Rotorua Lakes catchment many land areas have been colonized by gorse.

In a poster presentation at the LWQS Symposium 2008, Magesan et al conclude that considerable amounts of the Nitrogen continuously fixed by gorse accumulates in soil and eventually passes into water draining from the site. Groundwater enriched with nitrate-N may enter the lake system and contribute to lake water degradation. Nitrate concentrations in soil solution below the gorse rooting zone are sometimes higher than those acceptable for drinking water, but tend to decrease during winter months.

## Submissions

You can also send in a submission (download the form below). EBOP has designed a series of questions that may help you in producing a submission. Submissions close at 5pm on Friday 30 October 2009.

**Submission form**
(217KB, doc)

**To find out more:**

- Current Regional Pest Management Strategy (2.3MB, pdf)
- Consultation Document
- Technical Report (1.6MB, doc)

## Current Situation – Why Change?

**Boundary Control Pest Plants**
Blackberry, Gorse, Ragwort

**Current Direction**
Land occupiers shall, on direction of an Authorised Person, destroy blackberry or gorse within 10 metres of any property boundary, or ragwort within 50 metres of any property boundary.

**Current Offences**
A breach of a statutory obligation creates an offence under sections 52 and 53 of the Biosecurity Act 1993. A breach of any direction is an offence under section 154 of the Biosecurity Act 1993.

## Waikato University Professor funded by EBOP

### Professor David Hamilton

Environment Bay of Plenty (EBOP) made a major commitment to the restoration of water quality in the Rotorua Lakes through the establishment in 2002 of the Chair in Lakes Management and Restoration, based in Biological Sciences at the University of Waikato. A variety of student and collaborative projects is funded through the EBOP initiative. The overall aim of projects supported by EBOP is to provide the scientific basis to support for informed management decision-making by EBOP, in consultation with Iwi and the community.

Professor Hamilton had been with the Department of Environmental Engineering and the Centre for Water Research at the University of Western Australia, and previously gained his PhD at Otago University.

*"I hope to develop a predictive understanding of how lakes function using computer models, and to link these predictions with focused monitoring, research and management".*

Research will focus on the Rotorua group of lakes in the central North Island.

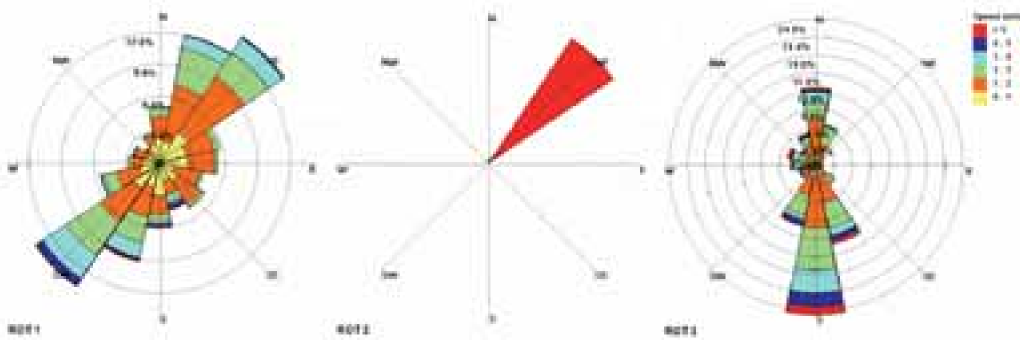
The Chair leads a review of lake research and monitoring programmes as well as undertakes high-level investigations into lake processes. Staff also participate in undergraduate, graduate and postgraduate teaching, and supervise student research on lake issues.

# Ohau Channel Diversion Wall

## David Hamilton

We set out to examine the effectiveness of the Ohau Channel diversion wall on Lake Rotoiti. Water currents at two sites in Lake Rotoiti near the diversion wall were somewhat aligned with the predominant wind directions at Rotorua Airport, but currents at the site in the Ohau Channel outflow within the diversion wall were relatively consistent and aligned in the direction of the diversion wall towards the Kaituna outflow. Current speeds in the Ohau Channel were generally several times larger than at the two Rotoiti stations. Around one year of water quality monitoring data have been analysed since the completion of the diversion wall. There is an indication of improvement in water clarity (viz., Secchi depth and turbidity measurements) and there have been low levels of chlorophyll a in Lake Rotoiti following diversion wall completion.

A substantial bloom of the blue-green alga Microcystis wesenbergii in Lake Rotorua late in summer 2008-9 did not appear to affect the western end of Lake Rotoiti – except for Okere Arm where the Ohau Channel entered – in contrast to blooms of similar magnitude in 2003-5, prior to the wall implementation. A remote sensing image of the western end of Lake Rotoiti on 17 November 2008 showed a marked difference in water clarity between the relatively turbid diversion channel water and the clearer water of Lake Rotoiti. The diversion wall appears to have greatly reduced inputs into Lake Rotoiti of nutrient enriched water arising from Lake Rotorua. Correspondingly, there is preliminary evidence of considerable improvement in water quality in the eastern end of Lake Rotoiti, based on increased water clarity, reduced levels of chlorophyll a and lower cyanobacterial biomass.



*Water current speeds and directions 1m above the lake bed at sites within Lake Rotoiti but near the Okere Arm, c. 200m apart (left and right) and within the Ohau Channel (middle). Percentages are based on 15-minute readings from 20 August to 9 September 2008.*


*Remote sensing image of Ohau Channel, Okawa Bay, Kaituna exit and western basin on Lake Rotoiti. Photo taken 17 November 2008. Image made available through agreement entered into for the licence from National Space Program Office of the National Applied Research Laboratories for the limited use of ROCST-2 satellite image and data by the University of Waikato, and supported through the Global Lake Ecological Observatory Network (GLEON). The horizontal resolution is 2 m and the image has been pan-sharpened from a true colour image through assistance from Mat Allan (University of Waikato).*

# Measurement of Nutrient Losses

## Great Work at Lake Rerewhakaaitu

A successful nutrient management project has been conducted in the Lake Rerewhakaaitu catchment. A rewarding feature has been the close interaction between farmers and science providers through frank discussions, regular farmer meetings and newsletters.

Lake Rerewhakaaitu is a shallow lake, unique amongst the Rotorua lakes in having catchment mostly comprised of dairy farms. In 2001, EBOP reported that lake water quality was satisfactory but noted that nutrient levels were increasing in streams flowing into the lake. Farmers within the catchment were concerned for the future condition of the lake water, and for the possible consequence of future constraints on their farming operations.

A two-phase Sustainable Farming Fund (SFF) project was set up to address water quality issues by identifying pastoral management practices in the catchment which could be changed to minimize the environmental impact on the lake, yet allow sustainable dairy farming to continue.

Phase 1 focused on Nitrogen management. A farmer survey was conducted and OVERSEER® nutrient budgets were calculated for 27 dairy farms. Predicted nitrate leaching was similar to other dairy catchments at 38kg N/ha/yr. It became clear that accurate area measurements of effluent paddocks were critical to accurate budgeting.

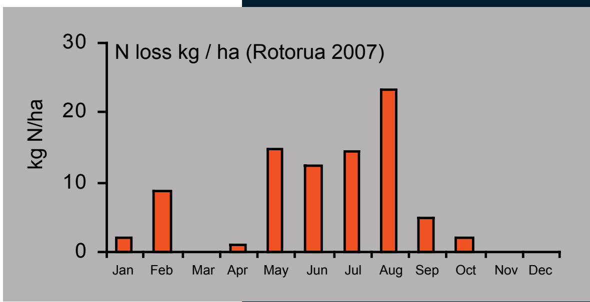
Nutrient loadings for nitrogen and potassium in the effluent areas were in excess of pasture growth requirements. Farmers therefore made the following changes –

- Nil or reduced application of N to effluent areas
- Reduced N fertiliser applications during autumn and winter
- Reduced total N inputs onto the farm

Phase 2 focused on phosphorus management. The measured Olsen P level of soils averaged 65, exceeding the 35-45 optimum. Farmers recognized the need to reduce average levels so that less P was lost by leaching from these susceptible Tarawera ash soils.

P losses tend to occur from critical source areas, rather than the whole catchment in general, so research focused on the identification of these areas, and the potential for on-farm mitigation. Five mitigation sites were selected within the catchment, and surface run-off measurements were made to evaluate the efficiency of P removal. Mitigation methods have included –

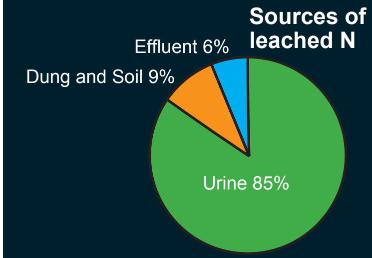
- Filter strips (both grass and artificial)
- Sediment traps
- P-socks filled with steel or iron slag
- Combinations of the above




*Ref : Dr Stewart Ledgard, AgResearch, Hamilton*

## Animal Inputs

Animal urine patches deposit nitrogen at the equivalent of 500-1100kg N/ha. Leaching from urine patches is high, especially in autumn and winter.




## Research

There is on-going research into the reduction of N losses and leaching.

- Altered diet composition by the inclusion of high sugar grasses, or low protein feeds such as maize silage - 20% less N loss
- The use of diuretcs such as salt - dilutes urine and increases volume, leading to greater spread and less leaching
- For the same level of N intake, N loss from sheep and deer is about half that from beef cattle, due largely to the greater spread of urinary nitrogen
- Trials in the use of nitrification inhibitors have shown potential for 20-50% decreased N loss
- Wetland development and stream margin plantings – preferably with maintenance and biomass harvesting.

## Lake Ecosystem Restoration NZ (LERNZ)

The LERNZ programme aims to identify and remediate threats to lake ecosystems. Through better knowledge of these threats and ways to manage them, improved methods for lake restoration can be developed

- New models and technologies to effectively manage harmful algal blooms
- New pest fish management and control technologies
- A city retrofit model

For more information on recent LERNZ activities, please visit: www.lernz.co.nz

# Food for Thought

## Regional Councils Take Action

The CraFarms Group – which owns 22 farms around the central North Island, and is the biggest private dairy operation in the country – has recently been sentenced on 34 counts of contaminating the environment. This has highlighted issues around what people can and can not do on their land. Allan Crafer, a principal of CraFarms, maintains that they have been unfairly targeted by Councils, the Resource Management Act, and the media, whilst doing a good job of increasing their production and enlarging their empire for the benefit of New Zealand.

Many farmers are now operating their farms under best management practices that minimize their environmental impact. The global market, Fonterra, central and local Government agencies, and the New Zealand public, are now demanding that we have a clean, green image.

It is therefore pleasing to see that Regional Councils such as Environment Waikato and Environment Bay of Plenty are taking strong action to penalise those that do not take their environmental stewardship seriously. Councils prefer to work alongside farmers in an educational role to ensure that farmers are complying with the RMA. But for the minority that continue to flout the rules that are now protecting our environment, the Councils are using penalties.

It is therefore difficult to have any sympathy for people like the CraFarm Group. Dairy farming is a business that has impact on the environment and it is essential that stewardship of the land is treated with respect. Most dairy farmers recognise this, and there are plenty of farmers out there now proving that profit and minimal environmental impact can go hand in hand.



## Whoops ... slipped out the gate

The owner of these cattle had not deliberately infringed. Nonetheless, all stock owners should be mindful that the grazing of lake margins is not a permitted activity under the Water and Land Plan (ref. Rule 8 – Stock Exclusion from Lake Rotoiti.

Urine is a major source of nitrogen that easily leaches into groundwater. Dung also has high nitrogen and phosphorus concentrations. Livestock are five times more likely to urinate and defecate when standing in water than on land, releasing large quantities of nutrients directly into the water.

Lakes WATER QUALITY Society

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