Nutrient Trading in Lake Rotorua: A Policy Prototype

Suzi Kerr, Hugh McDonald and Kit Rutherford

Motu Economic and Public Policy Research and NIWA
suzi.kerr@motu.org.nz

Motu

MOTU NOTE #10

Water quality in Lake Rotorua has been declining for at least the last 30 years as increased levels of nutrients have entered the lake. Despite significant effort and expenditure, the level of nutrients entering the lake still exceeds sustainable levels. A nutrient trading system would help the catchment achieve this goal for the least cost. Nutrient sources would bear the cost of their impact on water quality and hence take these costs into account in their decision-making. If the community decides to achieve its environmental goals using a nutrient trading scheme, this paper presents a scheme that would achieve nutrient loss reductions for the Lake Rotorua catchment cost effectively, whilst maximising participant flexibility and environmental certainty.

Introduction[1]

Lake Rotorua has faced significant declines in water quality over the past thirty years. The cause of this decline is increased nutrient leaching into the lake, caused by increased nutrient discharges by urban populations and, particularly, increased leaching from agricultural land in the catchment. The local community has indicated that cleaning up Lake Rotorua is a priority. A number of approaches could achieve the community's environmental goals. This paper presents a design for one innovative approach: a nutrient trading scheme.

The aim of this paper is not to argue for the introduction of a nutrient trading scheme. However, the trading scheme described here is attractive for three key reasons: it provides a high degree of certainty about environmental outcomes; it encourages those who can most cheaply mitigate nutrients to do so, achieving the environmental goal at lower cost; and it provides flexibility to nutrient sources – participants can operate as they see fit, as long as they hold enough allowances to cover their leaching.

A nutrient trading system controls nutrient loss by setting the total amount of allowances to leach nutrients equal to an annual cap on leaching that will achieve the desired water quality. Each allowance permits its holder to discharge a set level of nutrients, for example 1kg of nitrogen, from their property. An allowance can be used only once. It must be used on or after the date on the allowance. All nutrient sources included in the system monitor their nutrient loss and must surrender sufficient allowances to cover their discharges at the end of each trading year. If all sources comply, the goal is met.

Nutrient trading enables sources to receive direct financial benefits for reducing their nutrient leaching. If a source has insufficient allowances to cover their nutrient loss, they must purchase additional allowances from the market. If a source has surplus allowances, they can sell the extra allowances. Trading allows sources with high costs of achieving nutrient loss reduction to pay sources with a low cost of achieving nutrient

1 This paper does not provide detailed justification for the conclusions made. These justifications are provided in the underlying papers listed at the end of this note, which can be found at http://www.motu.org.nz/research/detail/nutrient_trading

The prototype proposed in this paper was developed over a number of years in conjunction with a group of local stakeholders, the Nutrient Trading Study Group. Acknowledgements and more details about the NTSG are available at the end of this paper.

loss reductions to undertake the necessary reductions, ensuring that nutrient reductions take place cost-effectively.

Nutrient trading provides a monitoring framework and financial incentive that facilitates other complementary policies. A nutrient trading system has been successfully used alongside a government-funded land buy-back and retirement scheme in Lake Taupō. Requiring best management practice for participants in a trading scheme is commonplace in international schemes. Education programmes and research and technology dissemination efforts will be more effective with a matching economic incentive. Regardless of the final policy mix chosen by regulators, many of the lessons and principles that inform the prototype presented below will be relevant.

While both nitrogen and phosphorus are important for long-term lake quality, we propose that nitrogen alone is managed through the trading scheme. We propose this for two reasons; phosphorus loss has changed little in recent years and the goal for reduction is modest; also, land use and management changes made to reduce nitrogen leaching may also decrease phosphorus runoff. Instead, we propose that phosphorus be monitored along with nitrogen, and the importance of managing both nitrogen and phosphorus should be made clear to landowners.

Setting a cap and defining allowances

Setting a cap

Before a nutrient trading system can be implemented, the acceptable level (or goal level) of nutrient load into the lake each year needs to be determined. The exact path toward these goals over time should be chosen through a well-informed political process that balances environmental and economic considerations. The setting of these goals is beyond the scope of this project and for the remainder of the paper we will assume these goals have already been determined.[2]

For a nutrient trading system, it is not the total amount of nutrients that reach the lake that needs defining, but the amount of leaching permitted from sources within the system: the "trading cap".[3] This trading cap determines the number of allowances available each year. In Rotorua, a significant proportion of nutrients enters the lake from "unmanageable sources", that is to say sources that will be outside of the trading cap. To achieve the desired environmental outcome, the total level of nutrients allowed to enter the lake from sources within the nutrient trading system (the "cap") must be the goal level minus the amount of nutrients that will enter the lake from "unmanageable sources".[4] Given full compliance, setting the cap at this level will ensure the water quality goal is achieved.

Landowners will only be accountable for nutrient leaching over which they have control. The largest unmanageable source is nutrients already in the groundwater system, which will enter the lake regardless of actions taken today. A baseline nutrient loss of 4 kg/ha/yr of nitrogen is also unmanageable; landowners cannot decrease leaching below this level (the leaching level of land in plantation forestry) and, as a result, will not be

[2] The Bay of Plenty Regional Council recently released a proposed regional policy statement which includes an objective of "enhancing the water quality in the lakes of the Rotorua district". Specifically, it states that nitrogen exports from land to Lake Rotorua shall not exceed 435 tonnes per year by 2022, a cut of 320 tonnes (Bay of Plenty Regional Council, 2012). This policy statement has not yet been accepted by council.

[3] For detailed discussion of issues related to the definition of allowances and the cap see Kerr et al. (2007).

[4] In this prototype system, all manageable nutrient sources are included in the system. If some nutrient sources were excluded from the system, then the trading cap would be even lower to take account of the nutrient loss from sources outside of the trading system.

responsible for the first 4 kg/ha/yr of nitrogen lost from their property.

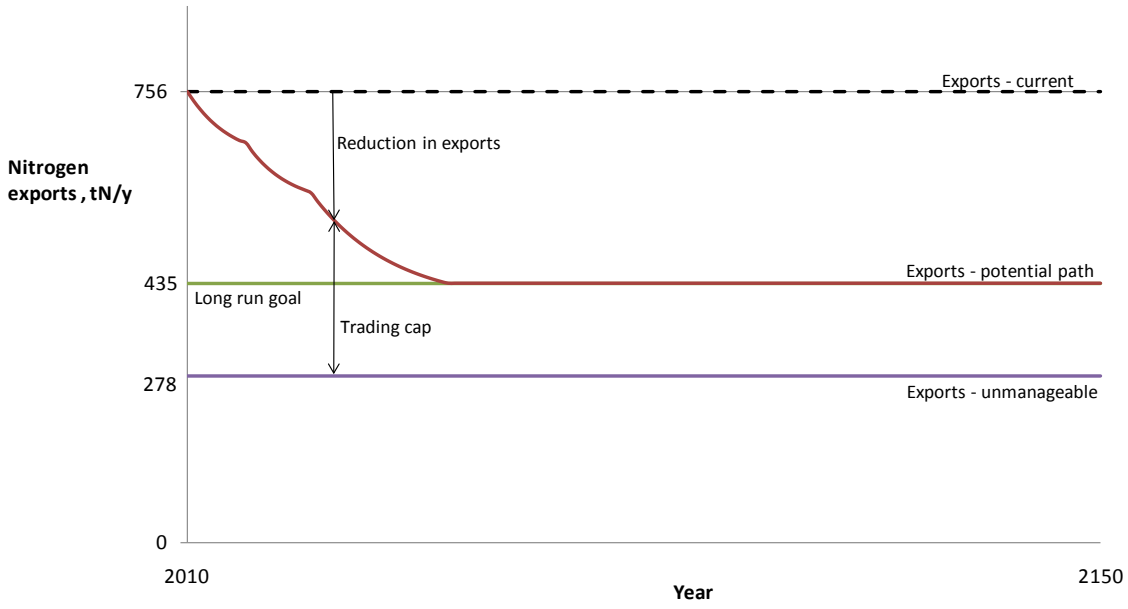
Participants should be allowed to "bank" allowances ("save" current allowances and use them to cover leaching in the future); that is, in 2020 participants could cover their leaching by surrendering allowances dated 2020, or dated any year earlier than 2020. Such a system is attractive as it would increase participant flexibility, lower transaction costs (participants will be able to costlessly "trade" with their future selves by saving allowances), and reduce allowance price volatility from fluctuations in weather and economic conditions.[5] During the transition to the long-run goal, society will value decreases in leaching today more highly than decreases in the future.

During the transition to the long-run goal, society will value decreases in leaching today more highly than decreases in the future.

Groundwater lags and attenuation

The location of each source in the Lake Rotorua catchment has implications for its contribution to the lake's water quality. While nutrients are well mixed within the lake, and water is resident in the lake for around two years, the location of a property determines how long nutrients take to get there. Nitrogen loss from some properties in the catchment can take up to 200 years to reach the lake because of groundwater lags. As off-site attenuation does not play a major role in the Rotorua catchment, the main difference between nitrogen losses from different properties is their arrival time at the lake. We investigated the possibility of accounting for this variability in the trading scheme using a series of "vintage" markets. Simulations of this more complex market indicated that the potential cost savings of accounting for these differences in location and time lag were small, and unlikely to outweigh the costs of the added complexity.[6] As a result, we propose that all sources' nutrient discharges be considered equal in the trading scheme, regardless of source location or time lag. Figure 1 illustrates the long run nutrient cap, and a cap which declines from current exports (nutrient losses from property) to achieve this.

Figure 1 The relationship between current, unmanageable, and desired exports in determining the trading cap



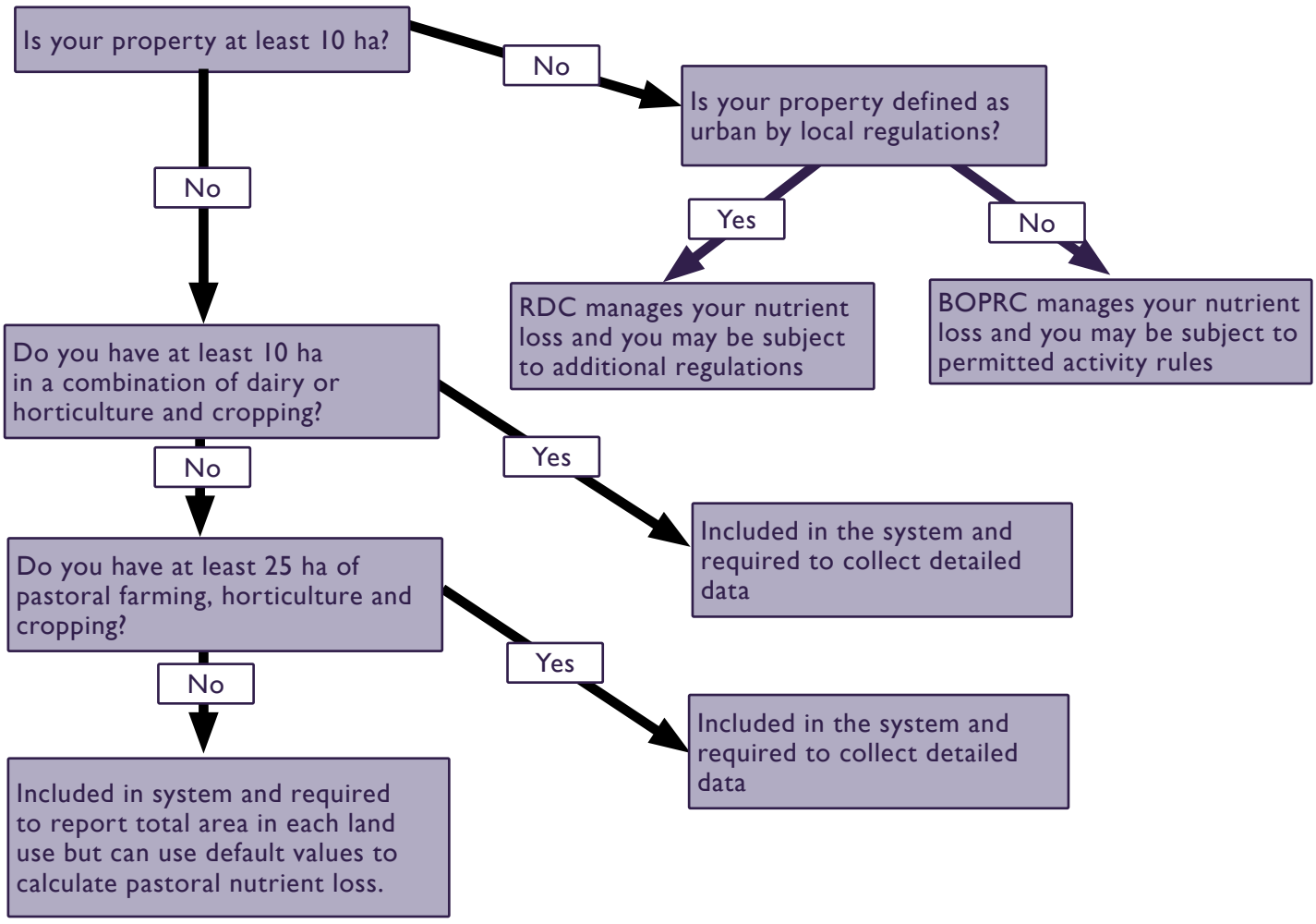
[5] In the long term, landowners are unlikely to bank enough units and release them suddenly to lead to excessive leaching in any two-year water residency time period, but limits on use of banked units could be implemented to ensure this.
[6] See Anastasiadis, Nauleau, Kerr, Cox, and Rutherford (2011).

However, if regulators plan to accompany the trading scheme discussed here with other policies, targeting these other policies at properties with short lag times, or at nitrates that travel through surface water flows, will maximise their effectiveness.

Who is included in the system?

All nutrient loss sources will be included in the system as this provides the most nutrient reduction options and is therefore the most cost effective; it also provides the most environmental certainty.[7] Plantation and indigenous forest are exempt unless they change land use. To avoid high compliance costs for smaller nutrient loss sources, we propose three different forms of participation (Figure 2). Nutrient sources will be direct participants in the system if the land use cover on their property exceeds at least 10 ha of combined dairy, horticulture and cropping land; if it exceeds at least 25 ha of combined pastoral, horticultural and cropping; or if they are point source dischargers. These participants are required to report detailed monitoring data to enable the

Figure 2: Rules for determining how a property is included in the nutrient trading system



[7] See Lock and Kerr (2008a).

nutrient loss model to be estimated. Nutrient sources that have properties of at least 10 ha but which do not meet the above thresholds are direct participants but are required to report only the area of each land use. Their nutrient loss from pastoral farming can be calculated using default values provided by Bay of Plenty Regional Council (BOPRC). These landowners will have the option of reporting more detailed data. All properties less than 10 ha are the responsibility of the Rotorua District Council (RDC) (if they are defined as urban under local regulations) or BOPRC (if defined as non-urban).[8] The Department of Conservation is responsible for their nutrient loss.

Allocation is always one of the most contentious issues in any trading system, because of the considerable costs that regulation can impose and the high value of the allowances. Therefore it is vital that the allocation rules are based on sound principles, are simple, and are based on readily available data that cannot be challenged.

Who receives allowances?

The allocation of allowances determines who bears costs. Allocation is always one of the most contentious issues in any trading system, because of the considerable costs that regulation can impose and the high value of the allowances. Therefore it is vital that the allocation rules are based on sound principles, are simple, and are based on readily available data that cannot be challenged.[9]

We propose that the system allocates the first few years of allowances to nutrient sources in proportion to their current nutrient loss to ease the initial economic impact. To avoid a situation where sources are incentivised to increase their current leaching to maximise their baseline allocation, we propose that this baseline is based on recent-past leaching. The benchmarks set by "Rule 11" could be used as this baseline.[10] This does not necessarily imply that sources receive sufficient allowances to cover their current nutrient loss, especially if the trading cap is lower than current nutrient loss levels.

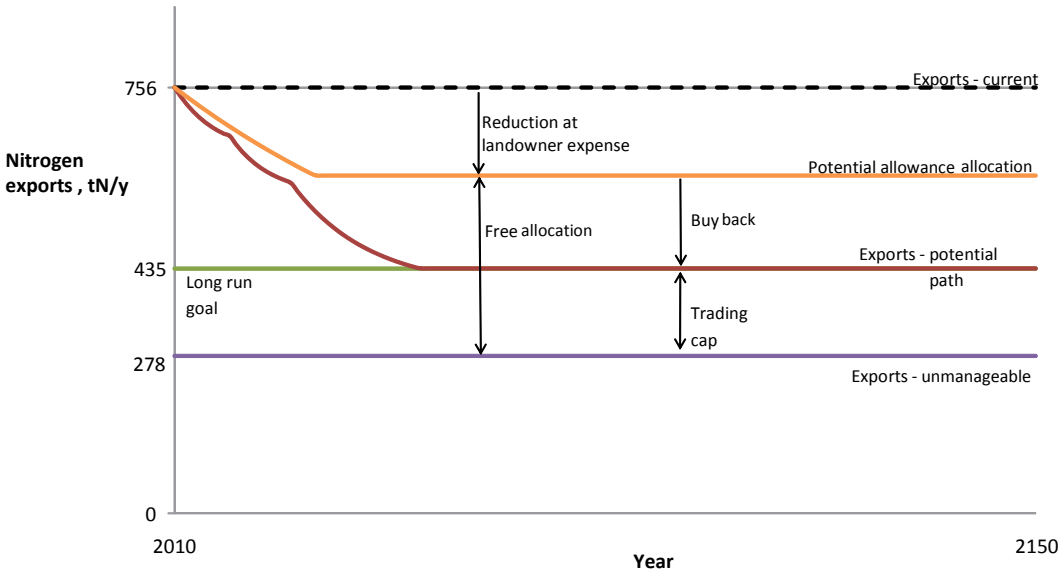
We propose that sources with low discharge rates (such as forest or undeveloped pastoral landowners, and those who have already carried out mitigation) should not be expected to decrease discharges as much as sources with high discharge rates. This could be achieved if, beyond the first few years, the allocation mechanism gradually transitions to a mechanism based on potential nutrient loss, providing a more equitable long-term system. This prevents landowners becoming trapped in their current land use if they do not have sufficient capital to purchase allowances and avoids rewarding high nutrient loss properties indefinitely. To enable this to happen, a measure of potential nutrient loss needs to be determined. One option is potential stocking rates (determined based on land use capability) applied through the OVERSEER® (Overseer) model with "standard" management practices on a common land use (e.g. sheep and beef farming).[11]

The same farm-specific calibration of Overseer that is used to monitor the system should be used for initial allocation. This will reduce risk to participants by aligning allocation and obligations to surrender. This also limits the incentives for participants to bias model calibration.

[8] Urban land is defined in BOPRC's Regional Water and Land Plan as "an area which contains an aggregation of more than 50 lots or sites of an average size of no more than 1000m2". The same definition should be used here to define urban and non-urban areas.
[9] Kerr and Lock (2009) presents the principles and considerations behind the approach proposed here.
[10] "Rule 11" was introduced as part of the Regional Water and Land Plan in 2005 (Bay of Plenty Regional Council, 2008). Landowners had nutrient loss benchmarks set, and were not allowed to exceed these limits. They could only intensify if they offset the nutrient increases by mitigating elsewhere. We propose that the historical benchmarking carried out under Rule 11 is used to guide initial allowance allocation.
[11] Given the magnitude of the nutrient cuts required in the catchment, in the longer run we expect few landowners will be freely allocated the full amount of their discharges; all are likely to face real costs. Sources would only be allocated more than their baseline discharges if their baseline discharges were especially low relative to their land's capability, such as from land that is currently in undeveloped pasture or forestry, but would make excellent dairy land.

Allowing nutrient sources as a group to maintain their current nutrient discharges will not achieve water quality goals and therefore it needs to be decided who will pay for the required nutrient loss reductions. If only the number of allowances equal to the goal were allocated, the environmental target would be achieved but most of the cost of nutrient reductions would be borne by the nutrient sources. In contrast, if sufficient allowances were allocated to cover current nutrient loss, and the government bought back and retired sufficient allowances to meet the goal, then tax- or ratepayers would bear all of the cost and nutrient sources could actually profit from the system. A point between these two extremes is likely to be ideal, with nutrient sources and central and local government each bearing some of the cost of achieving the reductions (Figure 3). In such a case, nutrient sources will be allocated fewer allowances than they need to cover current nutrient loss, and central and local government will buy some allowances from the market to achieve the remainder of the reduction required to reach the goal level of inputs.

Figure 3: Sharing the costs of reducing nutrient loss



The share of the cost of reduction paid by each of the parties should be explicitly defined. For instance, it may look like the following:

- X% through District Council buy-back
- Y% through Regional Council buy-back
- Z% through Central Government buy-back
- The remainder of the reduction is a cut proportional to initial allocation at landowners' expense.

This ensures that all parties bear some of the cost but that the reductions are not too great a burden on any party.

Allowances could be allocated up front for the first 25 years of the scheme, and then annually for each date 25 years into the future. Each successive year, one more year of allowances would be issued to keep the time horizon constant. This would allow greater certainty for long-lived investments such as forestry. To ease the sale of land and allowances together, we propose that the right to allowances not yet issued is attached to the land (rather than to the initial participant). As a result, when land is sold to new owners, the future allowance allocations will go with the land to the new owner, and will not continue to accrue to the initial participant. The value of these future allowance allocations will be reflected in the land price. The rules for long-term allowance allocation should be declared at the outset of the policy so that participants can be certain of their allocation going forward.

A potential equity problem could occur if, as a result of not yet fully understanding the system, allowance holders sell their future allowances prematurely or at a low price. In part to avoid this, in the Lake Taupo trading scheme cuts in the cap are achieved by a central institutional buyer (the Lake Taupo Protection Trust) buying and retiring allowances. The Trust provides business advice to potential traders to protect participants from making such mistakes. The Trust's purchases also "jump-start" the market. A similar approach could be used in Lake Rotorua to protect first time traders.

The penalty mechanisms set out in the current RMA will not be sufficient to create a stringent system: they are too small and too uncertain to induce compliance by all participants, and too expensive and time consuming for the regional council to enforce.

Reporting and compliance

Participants will be required to hold enough allowances to cover the discharges modelled by Overseer. The specific version of Overseer used to monitor nutrient loss will be fixed before each compliance year so that participants can use it throughout the year when making management, compliance and trading decisions. The Overseer model will be calibrated using average climate data rather than weather; for example, average rainfall will be used rather than the year's actual precipitation. This will ensure that participants are not held responsible for leaching that occurs as a result of factors outside of their control.

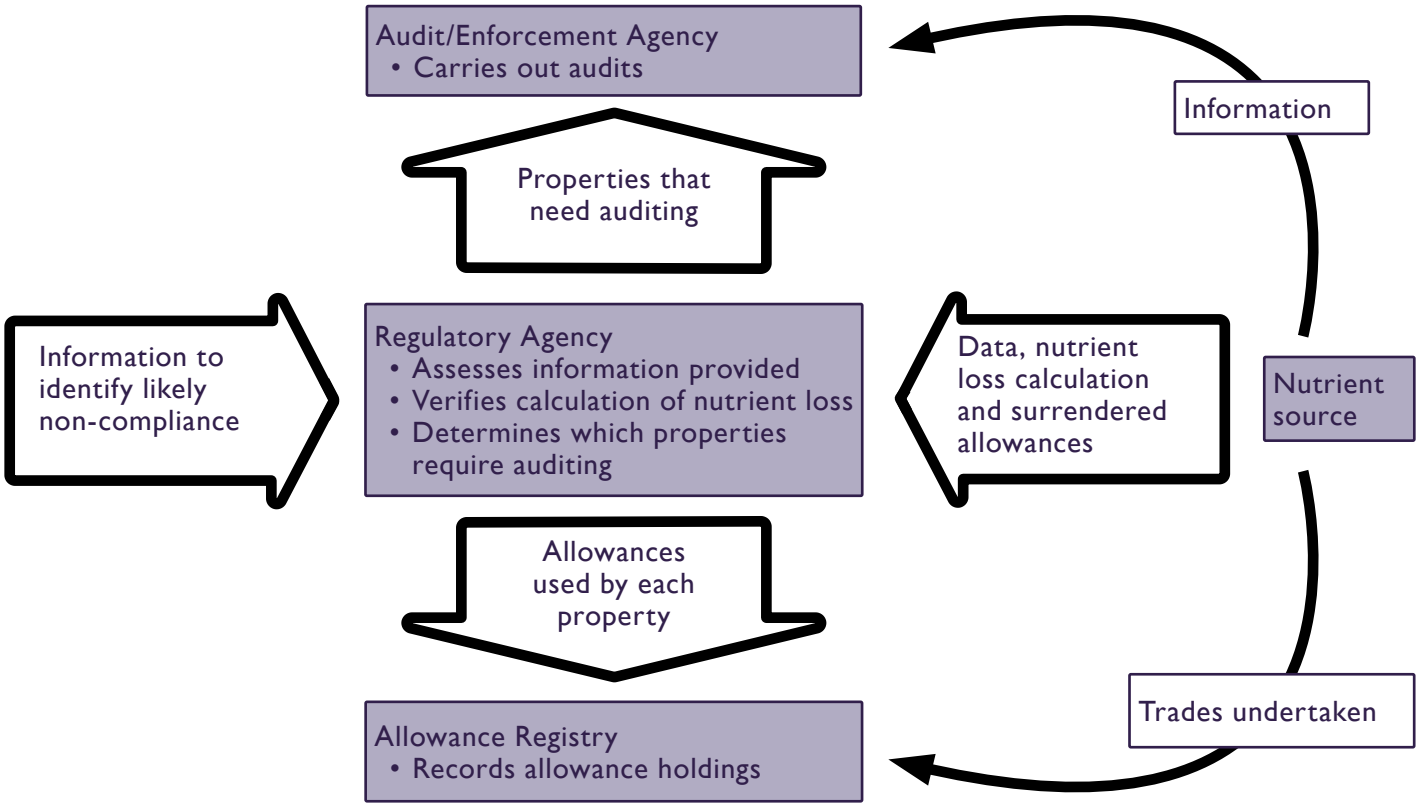
At the end of each compliance year every source must report data and run Overseer (or report a default value) to calculate the nutrient loss from their property.[12] The landowner must surrender enough allowances from their registry account at the end of each compliance year to cover all nutrient loss above the 4kg/ha/yr baseline level of discharge. The regulatory agency checks the returns and, if satisfied, passes information on the number of allowances to be surrendered to the registry. The regulatory agency also identifies properties to be audited. Properties can be audited for two different reasons: randomly or due to suspicious returns. An auditing agency undertakes these audits. Once the returns from a property are accepted, the registry removes the surrendered allowances from the property's allowance holdings. Nutrient sources that have insufficient allowances to cover their nutrient loss will face a penalty per missing allowance and will be required to make good the damage.

To ensure compliance with the system, significant participant "buy-in", or acceptance of the scheme, will be required, and penalties will also need to be large and easy for regulators to enforce. The regulator cannot currently set these penalties itself; the penalties that can be applied are defined by the Resource Management Act 1991 (RMA).[13] The penalty mechanisms set out in the current RMA will not be sufficient to

[12] Small properties reporting with default numbers could surrender several years of allowances at once and then report only when changing landuse.
[13] See Rive (2012) for an in-depth discussion of these legal issues.

create a stringent system: they are too small and too uncertain to induce compliance by all participants, and too expensive and time consuming for the regional council to enforce.[14] Specific, new, legislation that sets out offences and swiftly enforceable penalties for non-compliance will be required to ensure a robust scheme.[15]

Figure 4: Information flows in the nutrient trading system



Trading

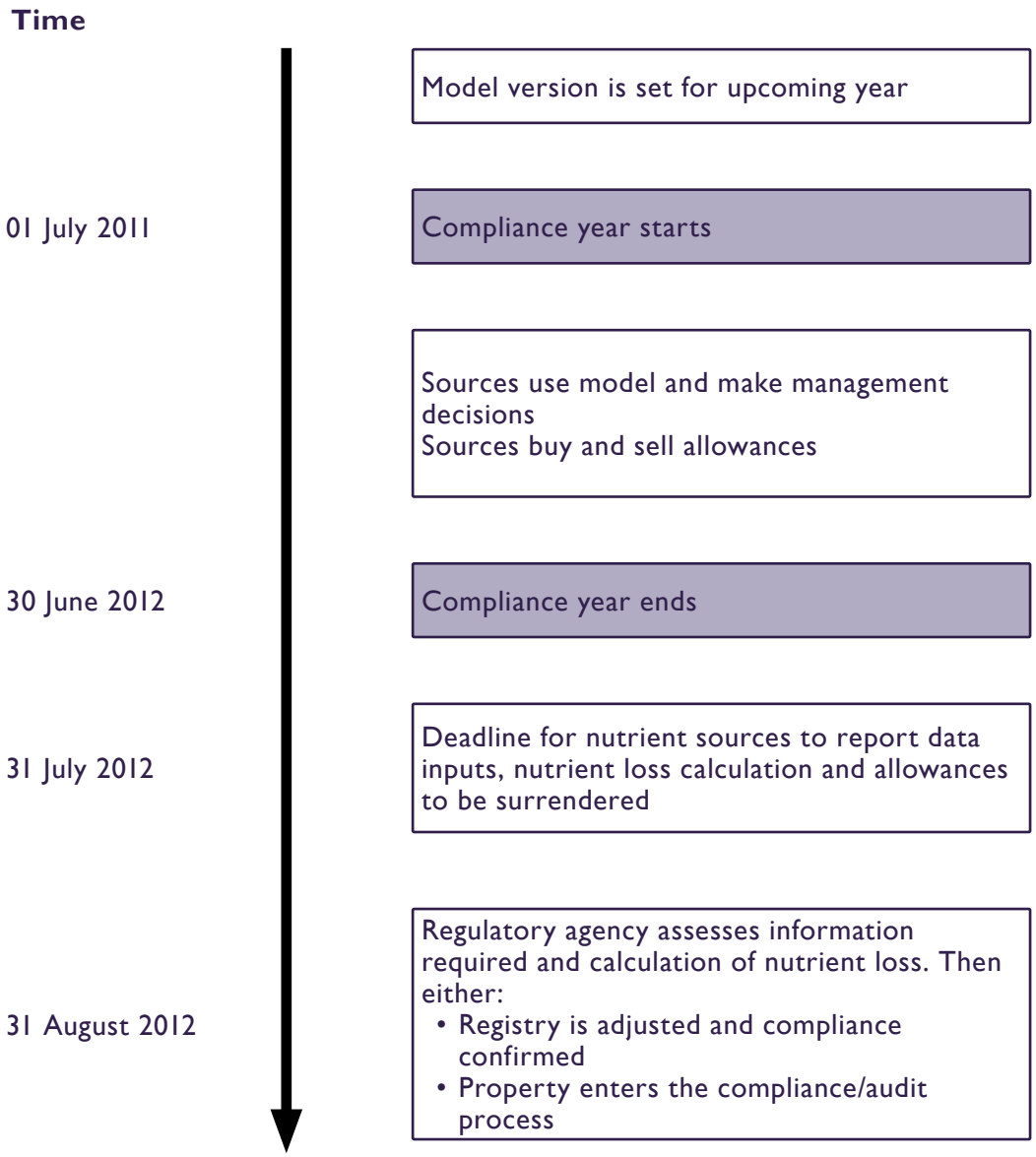
Individuals can trade allowances at any time. These trades can occur for any quantity and date of allowances. The price is negotiated between the two parties. Once the trade has been finalised, both parties need to inform the registry to update the participants' allowance holdings. No pre-approval of trades is required.

Ownership of nutrient loss allowances could be restricted to individuals who own land in the catchment. This would prevent outsiders from speculating on the market or locking up the allowances. Restrictions on how much any one entity can hold could be put in place to prevent monopolistic behaviour. Any restrictions should be strongly justified as they add complexity and reduce flexibility.[16]

Our legal advice suggests that this simple form of trading can, in theory, be developed and operated within the context of the current RMA.[17] However, as noted in

[14] The Taupō nutrient trading system has been established and is currently operating within the RMA and its enforcement mechanisms. They have not yet been tested. The larger nutrient reductions required to meet regional council environmental goals in Lake Rotorua may make "buy-in" more difficult to achieve than in Lake Taupō, where smaller reductions were required to achieve the environmental target. As a result, the threat of enforcement options is likely to be more important.
[15] An example of the type of legislation that would be useful is Part 4, Sub-part 4 of the Climate Change Response Act 2002, which established the penalty regime for the New Zealand Emissions Trading Scheme. An appropriate penalty regime would have graded penalties depending on the severity of the offence, and would be enforceable without the need to go through lengthy or expensive court proceedings. See Rive (forthcoming).
[16] See McDonald and Kerr (2011).
[17] See Rive et al. (2008).

Figure 5: Example of the possible timing of activities



We do not believe that the enforcement and penalties available under the RMA as it currently stands will be strong enough to achieve compliance with the nutrient trading scheme. We believe that specific legislative changes will be required to create an effective and efficient system.

the compliance section, we do not believe that the enforcement and penalties available under the RMA as it currently stands will be strong enough to achieve compliance with the nutrient trading scheme. We believe that specific legislative changes will be required to create an effective and efficient system.

Changing the system through time

A nutrient trading system designed for current conditions and with existing information will quickly become outdated as new information becomes available and social and political priorities change. In addition, a trading scheme is an innovative policy instrument and unanticipated issues are likely to arise. To avoid a lengthy and

potentially politically divisive process every time the system is altered, a clear adaptive management process should be put in place prior to the system's introduction. This will maximise certainty for participants. This management process should define how a decision to change the trading scheme will be reached and recognised, and what the process for implementing change will be. Two key features of the system that are likely to require updating in the future are future trading caps and the model that is used to monitor nutrient loss.

Deciding on a change

The group who determines how and when changes in the system occur may face intense lobbying and pressure as various groups try to manipulate the system to their advantage. Thus we propose a two-tiered system: an advisory group and a smaller decision-making group. Firstly, a fairly large advisory group bringing a range of perspectives considers the proposals for changes to the system, and then makes recommendations (which may not be unanimous). This group needs to be well supported by a strong research programme and technical advice. The group would present its recommendations, including any conflicting opinions, to a smaller decision-making group. The smaller group is charged with making the final decisions about changes in the system. This group should aim for consensus, but use majority voting if necessary, and be required to justify its decisions publicly.

Both of these groups should have a set of clear guiding principles. The groups should have open and generous discussion and base decisions on the strongest possible science (while not letting uncertainty paralyse the system). Furthermore, they should encourage innovation and avoid benefits to special interests. They should aim to protect property rights and the system as a whole to maximise investment certainty.

Once the smaller group decides on a change, the initial system design needs to be modified to incorporate this change. Below, we discuss two of the most likely and disruptive changes to the nutrient trading system and how the process to implement them could be defined in advance.

Changing trading caps

A clear set of rules specifying how the nutrient trading cap is decreased or increased (other than as specified when the system is created) would be outlined prior to the start of the system. These rules should specify how many years in advance any change is to be announced, and who will pay for (or gain from) the changes. This cost sharing should be based on the same principles as those used when initially allocating allowances at the schemes inception. For example, if allowance holders fund 30% of the initial reduction in allocated allowances, they would also fund 30% of any future reductions in the cap. Similarly, if the trading cap were increased, allowance holders would receive 30% of the newly created allowances.

Fixing these cost sharing rules in advance ensures that future decisions are only about the appropriate levels of the caps and not about who is paying for them. This should focus discussion on the optimal social decision rather than being biased by special interests.

Changing the nutrient loss model

When changes are made to the model (Overseer), landowners should not have to enter the market to purchase extra allowances in order to continue in their current land use and activities.[18] Changes to the regulation should not impose retrospective penalties (or rewards) on specific properties. We propose that landowners' allocation of allowances are adjusted to account for the increase or decrease in allowances now needed to cover their nutrient loss. This involves giving allowances to or taking allowances from landowners to ensure that they are no better or worse off. If the new model alters the aggregate level of nutrient loss, the adjustments to allowance levels to restore the environmental goal should use the same mechanism to address changes in the trading caps as outlined earlier. The same principles should be followed if Rotorua's "average" climate changes as a result of global warming. Updating the climate inputs into Overseer should not advantage or disadvantage participants. Making changes in this way will provide certainty for participants.

Conclusion

We believe that this prototype provides a good basis for assessing the feasibility and desirability of a nutrient trading system. We acknowledge that greater detail will be required to create a complete and functioning system. If a decision is made to explore this option further, this prototype, and the papers it references, provide useful guidance on areas that need more analysis and thought.

[18] See Kerr and Rutherford (2008).

The Nutrient Trading Study Group

The prototype proposed in this paper was developed over a number of years in conjunction with a group of local stakeholders, the Nutrient Trading Study Group. The following members of the Nutrient Trading Study Group believe that if a nutrient trading scheme is used to address water quality in Lake Rotorua, then it should closely resemble the prototype proposed in this paper:

Roku Mihinui (Te Arawa Lakes Trust)
Hera Smith (Te Arawa Lakes Trust)
Rob Pitkethley (Fish & Game Rotorua)
Don Atkinson (Lakes Water Quality Society)
John Green (Lakes Water Quality Society)
Henry Weston (Conservation sector)
Phil Journeaux (Ministry of Agriculture and Forestry)

The Nutrient Trading Study Group consisted of those listed above, along with those below:

Regular participants

Tina Ngatai (Māori Trustee)
Jamie Paterson (Federated Farmers and local farmer)
John Ford (Local farmer)
Kit Richards (Forestry sector)
Anna Grayling (Bay of Plenty Regional Council)
Suzie Greenhalgh (Landcare Research)
Richard Vallance (Ngati Whakaue Tribal Lands Inc.)
Rotorua District Council representatives

Collaborative process:

Glen Lauder (CommonGround)

Research team leaders:

Suzi Kerr (Motu)
Kit Rutherford (NIWA)

Acknowledgements

We would like to thank Bay of Plenty Regional Council, the Ministry of Agriculture and Forestry, the Ministry for the Environment and the Ministry of Science and Innovation for their financial support of the "Markets and Water Quality" research programme. We greatly appreciate input from Barclay Rogers, Vernon Rive, Cameron Law, David Hamilton, Doug Watt and many others. The authors remain responsible for any errors and omissions.

References

Anastasiadis, Simon, Marie-Laure Nauleau, Suzi Kerr, Tim Cox, and Kit Rutherford. 2011. "Does Complex Hydrology Require Complex Water Policy? NManager Simulations for Lake Rotorua," *Motu Working Paper 11-14*, Motu Economic and Public Policy Research, Wellington. Available online at http://www.motu.org.nz/publications/working-papers.

Bay of Plenty Regional Council. 2012. "Improving Water Quality in Lake Rotorua: Information on the Way Land is Used", Bay of Plenty Regional Council, Whakatane. Available online at http://www.boprc.govt.nz/media/31432/Policy-101109-ProposedRPS-fulldoc.pdf.

Bay of Plenty Regional Council. 2008. "Regional Water and Land Plan", Bay of Plenty Regional Council, Whakatane. Available online at http://www.boprc.govt.nz/knowledge-centre/plans/regional-water-and-land-plan/.

Kerr, Suzi and Kelly Lock. 2009. "Nutrient Trading in Lake Rotorua: Cost Sharing and Allowance Allocation," *Motu Working Paper 09-09,* Motu Economic and Public Policy Research, Wellington. Available online at http://www.motu.org.nz/publications/working-papers.

Kerr, Suzi and Kit Rutherford. 2008. "Nutrient Trading in Lake Rotorua: Determining Net Nutrient Inputs," *Motu Working Paper 08-03,* Motu Economic and Public Policy Research, Wellington. Available online at http://www.motu.org.nz/publications/working-papers.

Kerr, Suzi; Kit Rutherford and Kelly Lock. 2007. "Nutrient Trading in Lake Rotorua: Goals and Trading Caps," *Motu Working Paper 07-08*, Motu Economic and Public Policy Research, Wellington. Available online at http://www.motu.org.nz/publications/working-papers.

Land and Water Forum. 2010. *Report of the Land and Water Forum: A Fresh Start for Freshwater*, Wellington: Land and Water Forum. Available online at http://www.landandwater.org.nz/Site/Resources.aspx.

Lock, Kelly and Suzi Kerr. 2008a. "Nutrient Trading in Lake Rotorua: Choosing the Scope of a Nutrient Trading System," *Motu Working Paper 08-05,* Motu Economic and Public Policy Research, Wellington. Available online at http://www.motu.org.nz/publications/working-papers.

Lock, Kelly and Suzi Kerr. 2008b. "Nutrient Trading in Lake Rotorua: Overview of a Prototype System," *Motu Working Paper 08-02,* Motu Economic and Public Policy Research, Wellington. Available online at http://www.motu.org.nz/publications/detail/nutrient_trading_in_lake_rotorua_overview_of_a_prototype_system.

Lock, Kelly and Suzi Kerr. 2008c. "Nutrient Trading in Lake Rotorua: Social, Cultural, Economic and Environmental Issues Surrounding a Nutrient Trading System", *Motu Manuscript*. Available online at http://www.motu.org.nz/publications/detail/nutrient_trading_in_lake_rotorua_social_cultural_economic_and_environmental.

McDonald, Hugh and Suzi Kerr. 2011. "Trading Efficiency in Water Quality Trading Markets: An Assessment of Trade-Offs", *Motu Working Paper 11-15,*Motu Economic and Public Policy Research, Wellington. Available online at http://www.motu.org.nz/publications/working-papers.

New Zealand Government. 2011. "National Policy Statement for Freshwater Management 2011," New Zealand Government, Wellington. Available online at http://www.mfe.govt.nz/publications/rma/nps-freshwater-management-2011/docs/nps-freshwater-mgnt-2011.pdf.

Rive, Vernon.2012. "Nutrient Trading Programme Enforcement Issues," *Advice to Motu Research*, Vernon Rive Environmental Law, Auckland. Available online at http://www.motu.org.nz/publications/detail/nutrient_trading_programme_enforcement_issues.

Rive, Vernon; Barclay Rogers and Cameron Law. 2008. "Initial Report on Nutrient Trading under the Resource Management Act," *Advice from Chapman Tripp*, Chapman Tripp, Auckland. Available online at http://www.motu.org.nz/publications/detail/nutrient_trading_in_lake_rotorua_legal_mechanisms.