Allocating Lake Rotorua's sustainable nitrogen limit amongst land use activities

Background information, assessment of allocation approaches and initial analysis of potential options

Draft paper prepared by BOPRC staff, July 2012

Executive Summary

The proposed Regional Policy Statement requires that the total amount of nitrogen entering Lake Rotorua shall not exceed 435 tonnes per annum. Recent modelling indicates that the current nitrogen load to the lake from the catchment is approximately 755 tN/yr. To achieve the 435 tN/yr sustainable nitrogen limit, a reduction of 320 tN/yr is required.

The proposed Regional Policy Statement also requires that the 435 tonne limit be allocated amongst land use activities. There are two critical steps required in the decision to allocate the sustainable limit:

1. Determining how much of the sustainable limit is available to be allocated to pastoral land use activities given the current sources of nitrogen that have been identified through lakes modelling
2. Specifically allocating the initial nitrogen discharge allowances to pastoral land use activities within the catchment, in such a way that will achieve the sustainable limit

Given unmanageable loads (e.g. rain and forest), as well as interventions already planned (e.g. for geothermal and urban loads), 270t of the total reduction required will need to come from pastoral activities. The current estimated loss of nitrogen from pastoral land is 526 tN/yr. To achieve the sustainable limit, the total pastoral loss must be reduced to 256 tN/yr, a 51% reduction.

There are a variety of ways that nitrogen could be allocated to land use activities across the catchment, to achieve 256tN/yr. A number of different allocation approaches were assessed against a variety of criteria with two options considered appropriate for the Lake Rotorua catchment:

a. Allocation using a sector average approach – an allowance of 26.5 kg N/yr is proposed for the dairy sector, and an allowance of 7.7 kg N/yr is proposed for the drystock sector.
b. Allocation using a grandparenting approach – where individual allowances will equal 51% of benchmarked discharges.

The implications of both options on the Lake Rotorua catchment are assessed in detail, including advantages and disadvantages of each. In terms of the distribution of total costs for individuals, those with low baseline leaching are unequivocally better off under a sector based approach, and farmers whose nitrogen losses are higher than the sectors average are better off under a grandparenting approach.

Modelling indicates that most of the reduction in nitrogen loss under both approaches will come from dry stock farmers and more than half are projected to fully convert to forestry use. The drystock sector faces higher total mitigation costs than the dairy sector. However if a trading scheme is in operation then drystock farmers who undertake these mitigations could potentially sell valuable allowances to dairy farmers, offsetting their cost of mitigation.

Likewise, if a trading scheme is operating dairy farmers are likely to be better off by purchasing allowances from outside the sector (i.e. by paying dry stock farmers to perform nitrogen mitigation for them). Because of this demand for additional allowances, the total cost to the dairy sector is higher (both per hectare and overall).

Assessing the Rule 11 benchmarking data shows that more dairy and drystock farmers in the Rotorua catchment will receive a higher allowance under the sector average approach than the grandparenting approach. For dairy farms, a grandparenting allocation approach will mean 8 of the 25 benchmarked farms will receive a **higher** allowance than they would have under the proposed sector allowance of 26.5 kg N/ha/yr. Conversely, a grandparenting allocation approach will mean 17 of the 25 benchmarked farms will receive a **lower** allowance than they would have under the proposed sector allowance of 26.5 kg N/ha/yr.

For drystock farms in the Rotorua catchment, a grandparenting allocation approach will mean 57 of the 141 benchmarked farms will receive a **higher** allowance than they would have under the proposed sector allowance of 7.7 kg N/ha/yr. Conversely, a grandparenting allocation approach will mean 84 of the 141 benchmarked farms will receive a **lower** allowance than they would have under the proposed sector allowance of 7.7 kg N/ha/yr.

Ultimately, both options have the same impact across the catchment. This is because both will achieve a catchment wide reduction from 526 tN/yr to 256 tN/yr. However, the way in which the costs are spread is very different under each approach.

There is no 'right way' to allocate allowances as there is no generally agreed upon definition of how cost should be fairly shared amongst individuals or sectors. The best allocation system will be the one that the community agrees is fair and politically acceptable. Choosing an allocation method is a political decision.

Council needs to be aware that the cost of meeting the nitrogen target for the lake is very high. There will be significant and direct costs to pastoral farmers, and indirect costs and downstream impacts to industries such as suppliers, manufacturers, processors, contractors and to the Rotorua community in general.

For example, the Farmer Solutions Project conservatively estimated that delivering a 240tN/yr reduction[1] would have a farm gate cost of around $88 million. The Project also estimated that the reductions required from pastoral land use will result in an aggregate sheep and beef farm value loss of $35 million. The follow on effects to the catchment and regional economy of these costs will be significant. These costs need to be considered alongside the broader benefits of a cleaner lake.

Council also needs to be aware of the inherent assumptions and uncertainties in the science and information used to determine the sustainable limit, current nitrogen inputs to the lake, and the reductions required to achieve the sustainable limit. The way in which any allocation approach is implemented will need to be responsive and adaptive to new science and information, if and as it emerges.

[1] Note the Farmers Solutions Project assesses costs of delivering a 240 tN/yr reduction, not a 270 tN/yr reduction

1.0 Purpose

The purpose of this paper is to:

a. provide the background for why nitrogen allocation is required in the Lake Rotorua catchment
b. outline information available to support decisions, as well as the potential impacts and benefits of allocation
c. determine how much of the sustainable limit is available to be allocated to pastoral land use
d. provide an assessment of allocation approaches that could be used to allocate nitrogen amongst pastoral land use activities in the catchment
e. present an analysis of two potential allocation options available to Council that will ensure the catchment's sustainable limit can be achieved
f. note other issues that Council needs to be aware of (e.g. gorse and multiple owned Māori land)

2.0 Background

A water quality target for Lake Rotorua has been set in the Regional Water and Land Plan. This target is a Trophic Level Index (TLI) of 4.2, based on community consultation and a desire for the level of water quality enjoyed in the 1960s. The target has been endorsed by all partners of the Rotorua Te Arawa Lakes Strategy Group.

The Lake Water Quality Technical Advisory Group has confirmed that to reach the target TLI of 4.2 no more than 435 tonnes of nitrogen should enter Lake Rotorua each year.

Modelling undertaken by NIWA in February and April 2011, using the Rotorua and Taupo Nitrogen (ROTAN) model, indicates that the current nitrogen input to the lake from the catchment is approximately 755 tN/yr. This means the nitrogen entering Lake Rotorua from the catchment needs to be reduced by approximately 320 tonnes a year.

Table 1 identifies the sources of nitrogen entering Lake Rotorua from the catchment. Almost 70% of the catchment nitrogen load comes from pastoral land use activities.

The estimates provided in Table 1 are derived from the ROTAN model. Recent land management and land use changes are likely to have reduced pastoral nitrogen loss from these estimates. The Farmers Solutions Project (an initiative of the Lake Rotorua Primary Producers Collective and funded by BoPRC) has estimated that, on average, nitrogen loss from dairy farms may be up to 18tN/yr lower than modelled in ROTAN.

Staff note that there are some inherent assumptions and uncertainties in the science and information used to determine the TLI, sustainable limit, as well as current nitrogen inputs to the lake. These assumptions and uncertainties are outlined in Appendix A.

Table 1: Sources of nitrogen entering Lake Rotorua from the catchment[2].

[2] Nitrogen figures are based on the most up to date ROTAN modelling work done in April 2011

Source of nitrogen	Area in use (ha)	% of total catchment	Total tN/yr (in 2010)	% of total N	Average kg N ha/yr
Dairy	5050	10.9	273	36.2	54.1
Drystock[3]	15072	32.5	236	31.3	15.7
Forest	21182	45.7	75.4	10.0	3.6
Urban[4]	3961	8.5	93.4	12.4	23.6
Lifestyle	1053	2.3	16.7	2.2	15.9
Geothermal	59	0.1	30.3	4.0	513.6
Rain	n/a		30	4.0	
TOTAL	**46377**	**100**	**755**	**100**	**16.3**

Partners, stakeholders and the community have come a long way to get to this point where we can identify exactly what needs to be done to improve water quality in Lake Rotorua. Key milestones include:

- An aspirational TLI is identified and included as a target in the Regional Water and Land Plan (2001)
- Rule 11 in the Regional Water and Land Plan is implemented to cap diffuse nitrogen losses from pastoral activities in the catchment at 2001-04 levels (2008)
- Actions required to improve water quality are agreed through development of the Lake Rotorua and Rotoiti Action Plan (2009)
- The Primary Producers Collective and Lakes Water Quality Society sign the Waiora Agreement and agree to work together to achieve a clean and healthy Lake Rotorua (2011)
- Bay of Plenty Regional Council, Federated Farmers Rotorua and the Primary Producers Collective sign the Oturoa Agreement to identify the intent of all parties in meeting the lakes' sustainable load (2013)
- Significant investment in improving the science and information base (ongoing).

2.1 Policy direction

The effect of nutrient discharges on the Rotorua Te Arawa lakes has been identified as a regionally significant issue in the Proposed Regional Policy Statement 2012-2022 (Proposed RPS).

The Proposed RPS provides specific direction for the management of nitrogen in the Lake Rotorua catchment[5] as follows:

- **Policy WL 3B:** the total amount of nitrogen that enters Lake Rotorua shall not exceed 435 tonnes per annum
- **Policy WL 5B:** allocate the 435 tonne limit amongst land use activities
- **Policy WL 6B:** no discharges shall be authorised beyond 2032 that result in the 435 tonne limit being exceeded. An intermediate target is to be set to achieve 70% of required reduction by 2022.

Despite the timeframes specified in the Proposed RPS for achieving the sustainable limit, nutrients from the catchment will take a long time to travel through groundwater to the lake. Changes in the way land is used

[3] Including sheep, beef, horticulture and cropping
[4] Including urban (25.5t), urban open space (8t), septic tanks (26.2) and sewage treatment (33.7t)
[5] During the development of the Regional Policy Statement, it was decided the difference between the current and sustainable loads of *phosphorus* into Lake Rotorua was not so great as to require a limit to be set.

could take many years before they are effective in decreasing nutrient loads to the lake. For example, ROTAN results indicate that once nitrogen losses are reduced by 320 t/yr it will take 35 years for the lake to be within 10-15% of the sustainable limit. However, it may take up to 100 years for the lake load to fully adjust and reach the sustainable limit as a 'steady state'.

This paper relates specifically to giving effect to Policy WL 5B.

2.2 Lake Rotorua Stakeholder Advisory Group

The Lake Rotorua Catchment Stakeholder Advisory Group was established in September 2012 to, in part, support this development of policy on allocation.

The main purpose of the Group is to provide oversight, advice and recommendations on "rules and incentives" options that will achieve the nitrogen reduction targets needed from rural land to meet Lake Rotorua's water quality target. This includes advice on implementation options and District and Regional statutory plans.

The Group includes members from the Lake Rotorua Primary Producers Collective, Lakes Water Quality Society, Bay of Plenty Regional Council, Rotorua District Council, Te Arawa Lakes Trust, Office of the Maori Trustee, forestry sector, iwi landowners and small block owners.

The Group first convened in November 2012 and have met every month since. They have been involved in the development of policy on allocating nitrogen allowances, considering options and the information available.

2.3 Impacts of achieving the Proposed RPS sustainable limit

An assessment of the impacts associated with achieving Lake Rotorua's sustainable nitrogen limit has already been made as part of the Proposed RPS process. It is important, however, that Council has a technical appreciation of the impact that implementing Proposed RPS policies will have, and understands the significance of what is being proposed.

Currently, there is no agreed or documented set of costs or benefits that should be considered for making decisions related to freshwater resources. There are some useful resources to draw upon to assist with identifying a consistent set of costs and benefits to consider, including the National Policy Statement for Freshwater Management which outlines values and uses for freshwater.

It is important not to limit assessments to monetary values but to include both qualitative analysis and quantitative assessment that may use other metrics than monetary value. Services/values/uses can be valued to provide information that improves decisions by taking into account the costs and benefits of those decisions on the natural environment.

A summary of the potential costs and benefits of achieving the sustainable limit are provided.

Costs associated with achieving the sustainable limit

Achieving the sustainable limit will have significant social and economic impacts, both locally as well as across the region. The scale of nitrogen reduction required, particularly by the pastoral sector, means that these impacts will occur regardless of any allocation approach that Council chooses to implement.

There have already been substantial costs to the community to improve water quality. This includes $95 million that has been agreed through the Deed of Funding with the Crown to fund actions to remove nitrogen and phosphorous in Lake Rotorua.

It is hard to estimate the true cost of change to pastoral sector with any precision because the details of allocation and rules are not yet known. However, we do know that the scale of change required means that achieving the sustainable limit is not just about changing management approaches or adopting new technologies. It will require a significant shift in the way land is used in the catchment, and potentially lower profits and farm value resulting in economic and social impacts for the wider community.

Information is available to broadly estimate the cost of change, and is extremely important in the context of allocating nitrogen in the catchment. This includes:

- Beca[6] analysed a complete suite of intervention packages that could reduce nutrient loads in Lake Rotorua to a sustainable level. The analysis indicated costs in the range of $40 to $90 million depending on land use scenarios and implementation timeframes.
- The Farmers Solution Project looked at the efficacy of nitrogen loss mitigation on 12 dairy and sheep & beef operations within the catchment. It was estimated that a reduction of 31.7tN/yr could be achieved through land management changes for a cost of $171/kg N, while land use change could provide an additional 21.7t of nitrogen reduction at a cost of $1,036/kg N. Extrapolated across the catchment it was estimated that a reduction of 240 tN/yr could be achieved at a *farm gate cost* of $88 million.
- The Farmers Solution Project also estimated that the reductions required from pastoral land use will result in an aggregate sheep and beef *farm value loss* of $35 million.
- Landcare Research evaluated the impact of different policy options for managing to water quality limits in select catchments, including the Lake Rotorua catchment. Landcare's analysis suggested that achieving the sustainable nitrogen limit by 2022 would cost $3.2 - $3.9 million per year. This estimate is much lower than the two previous examples as it assumes nitrogen can be purchased and sold from willing sellers and buyers.

Although each study has used very different methodologies and modelling techniques, it is clear that achieving the sustainable nitrogen limit in the Lake Rotorua catchment will have significant and direct costs, particularly to pastoral farmers. There will also be indirect costs and downstream impacts to industries such as suppliers, manufacturers, processors, contractors and to the Rotorua community in general.

The negative impacts above could partly be relieved by the Lake Rotorua incentives scheme being developed concurrently with the development of allocation options. Under this scheme, it has been proposed that $45.5 million dollars be used to encourage land use change in the catchment to reduce nitrogen loss and help achieve the sustainable limit. The development of the Incentive Scheme and the criteria for who is eligible for funding will be influenced by the identification of those affected most by this allocation process. However, the reality is there will still be a significant gap between the potential economic costs to farmers and the likely incentive funding available.

It should be noted that innovation in mitigation techniques and practices may reduce total costs and impacts over time. Most economic and policy analysis is conservative with respect to adaptations because they are inherently hard to predict.

Benefits of achieving the sustainable limit

No attempt has yet been made to quantify the benefits associated with a clean Lake Rotorua. Sectors of the economy linked to water quality in the Bay of Plenty include recreational fishing, tourism, lake related businesses, lakeside properties, and lake related recreational activities apart from fishing.

[6] in association with NIWA, Nimmo-Bell, AgResearch, GNS Science and Market Economics

Importantly, achieving the sustainable limit for the lake will ensure that the traditional relationship of Te Arawa with the lake is recognised and provided for and that the Mauri of the water is protected.

There will also be benefits associated with changes in the way land is used in the catchment. This includes increased tourism, new opportunities such as the potential growth of forestry and new industries, and an increase in employment from other sectors.

There is likely to be significant other benefits from improved water quality in the lake, including greater 'intangible' non-market benefits, increased recreational opportunities, and the enhanced provision of many other ecosystem services (for example, improved amenity or aesthetic values).

It is difficult to provide precise figures on the market and non-market value of water quality to the Rotorua Lakes district. However, lake water quality is inextricably linked with Rotorua's economy. For example:

- The tourism industry contributes nearly $600 million to the local economy (2011 figures), and a large number of jobs in the district are tourism related. In 2005, a perception study showed that water quality would affect travel decisions for a significant proportion of respondents. Even a 1% reduction in tourism numbers would reduce the annual tourist spend by nearly $6 million. It is also possible the local population may decide to holiday elsewhere if water quality in Lake Rotorua is degraded.
- The Rotorua Lakes trout fishery accounts for up to 30% of trout licenses sold nationally. In 2001, the fishery had a national value of almost $300 million. Poor water quality not only affects the health of the fishery, but a 2011 survey on the Rotorua Lakes showed poor water quality will also result in anglers choosing to fish elsewhere.
- International studies have shown decreases in water quality directly impact property values by 10-50%. The current value of properties in proximity to the four Funding Deed lakes has been estimated at $1,319 million. Improving water quality has the potential to increase these property values.

Staff note that it is not just Lake Rotorua that attracts tourists and fishers. Understanding the lakes' direct contribution to things like tourism, fisheries and property values is difficult. Staff also note that the agricultural sector tends to provide higher value jobs than either tourism or forestry. The figures are provided just to acknowledge a correlation between a clean lake and the broader economy.

3.0 Allocation of nitrogen discharges

The Regional Policy Statement requires that the sustainable limit of 435 tN/yr be allocated amongst land use activities in the Rotorua catchment.

Staff consider that there are two critical steps required in the decision to allocate the sustainable limit:

1. Determining how much of the sustainable limit is available to be allocated to pastoral land use activities given the current sources of nitrogen that have been identified through lakes modelling
2. Specifically allocating the initial nitrogen discharge allowances to pastoral land use activities within the catchment, in such a way that will achieve the sustainable limit

3.1 Pastoral land use within the sustainable limit

This step is about determining how much of the 435t sustainable limit is available to be allocated to pastoral land use activities within the Lake Rotorua catchment.

Table 1 identifies the current (2010) sources of nitrogen loss to the lake from the catchment and is used as the baseline source information for the assessment of impacts and allocation options. To achieve the sustainable limit a total reduction of 320 tonnes N/yr is required. Not all nitrogen losses from the catchment can be reduced. Nitrogen that comes from rainfall on the lake cannot be managed or reduced. Losses from forest and bush are also considered to be 'unmanageable' because they are a relatively natural state and cannot be reduced any further.

Significant effort has already been made to reduce nitrogen from urban sources. For example, upgrading Rotrorua's Wastewater Treatment Plant and installing and upgrading the Land Treatment system has cost $60 million since 1990. This has stopped between 120 and 290 (current) tonnes of nitrogen reaching Lake Rotorua each year.

Further engineering interventions to reduce nitrogen from some sources have also been planned for (costs and progress are outlined in Appendix B). These are:

- *Geothermal sources*: interventions are underway to completely remove nitrogen that enters the lake from geothermal sources by treating the Tikitere geothermal springs. This is predicted to achieve a 30tN/yr reduction.
- *Urban sources:* A further reduction of 20 tN/y from urban sources is planned from sewage reticulation/upgrades and stormwater treatment.

Given the unmanageable loads identified, as well as the 50 tonnes of reductions from engineering interventions already planned, further reductions to achieve the sustainable limit will need to come from pastoral activities.

Therefore the nitrogen available to be allocated to pastoral land use activities is provided at Table 2.

Table 2: Nitrogen available to be allocated to pastoral land use activities

Source of nitrogen	Current nitrogen input (t/yr)	Proposed distribution of the sustainable limit
Pastoral land use (dairy, drystock, lifestyle)	526	256
Other (urban, sewage, geothermal, rain, forest	229	179
TOTAL	**755**	**435**

Staff emphasise that this step is not about allocating nitrogen to sources such as forest, urban and sewage and geothermal. There is a risk that inputs associated with these sources may change over time. For example urban losses may increase if the Rotorua population grows, and reductions from geothermal inputs are not guaranteed. These risks will need to be dealt with separately, as they arise, through the Rotorua Te Arawa Lakes Programme.

3.2 Allocating nitrogen discharge allowances to land use activities

This step is about specifically allocating nitrogen discharge allowances to land use activities within the catchment, in such a way that will achieve the sustainable limit. This means that for pastoral land use, the amount of nitrogen discharge allowances that can be allocated will need to be more than halved (a 270 tonne N/yr or 51% required reduction), from the current loss of 526tN/yr to 256tN/yr (see Table 2).

The scale of change required for pastoral losses means that every pastoral farmer in the Rotorua catchment will be affected by the allocation of discharge allowances.

There are a variety of ways that nitrogen could be allocated to land use activities across the catchment, to reduce pastoral land use loads to 256tN/yr. The main methods, from the national and international literature, are:

Allocation Approach	Explanation
Grandparenting	Allocation is based on existing discharges benchmarked under Rule 11. However, to reduce the current pastoral discharge of 526 tN/yr to the required 256 tN/yr a 51% reduction would need to be applied to each benchmark.
Pastoral averaging	This is where the sustainable pastoral load (256 t) is divided by the pastoral catchment (21,175 hectares) to give an average N leaching of 12kg/ha. Every pastoral landowner in the catchment would receive 12 kg/ha.
Sector averaging	This method allocates an averaged level of nitrogen discharge rights across specific types of land use or "sectors" e.g. dairy and drystock.
Land use capability	This approach assesses the physical quality of the land, soil and environment. Higher nitrogen limits would be allocated to more versatile classes of land, thus improving overall efficiency of land use in the long run.
Input based limits	Focuses on controlling the inputs to land use operations by directly managing the amount of nutrients being applied on land. For example, controlling stock numbers, fertiliser and feed application rates.
Output based limits	Based on the greatest units of output leaving a property (e.g. milk solids, timber, kg of meat). An example would be allocating to a landowner based on how many kg of milk solids or revenue produced per 1 kg of nitrogen leached.

Any allocation approach is going to have implications for:

- Public and private equity
- Economic viability of various sectors
- Future land use patterns
- Future land and urban development opportunities
- Social, cultural and economic development.

Therefore, the allocation approach needs to be aligned to the characteristics of the Lake Rotorua Catchment and its community.

Potential allocation approaches for the Lake Rotorua catchment

Staff and the Stakeholder Advisory Group assessed each of the allocation approaches outlined above, using two sets of criteria. The criteria were:

- The principles and considerations of allocation that must be given regard to as specified in Policy WL 5B of the Proposed RPS
- Guidelines developed by the Stakeholder Advisory Group

The criteria and assessments are provided in full for information at Appendix C.

While it is clear that there are pros and cons associated with all allocation approaches, two options could be considered appropriate for the Lake Rotorua catchment:

Option One: Allocation using a sector average approach

Option Two: Allocation using a grandparenting approach (including a proportionate reduction)

A hybrid model could also be tailored for the catchment, using aspects of the various allocation approaches that may have merit. Different combinations of allocation options can be used to balance out burdens placed on different sectors. Using hybrid allocation approaches also allows for variations to be made for environmental reasons. For instance, a smaller allowance may be given for areas within a catchment where the receiving environment is particularly sensitive.

Nitrogen trading

Elements of this report (for example advantages and disadvantages of the allocation approaches) have been written under the assumption that some form of nutrient trading may be possible. Council will need to decide whether or not a trading scheme will be used to provide flexibility to any regulated allocation of nutrients in the catchment and if so how the scheme might function. A specific report with more detail on nutrient trading will be presented to Council for decision.

4.0 Assessment of allocation options

4.1 Option One: sector based averaging

Under this approach, each hectare of land receives an allocation based on the average amount of nitrogen losses associated with land use. The allocation to each hectare of dairy is the same and the allocation to each hectare of drystock is the same.

Figure 1 presents an example of ten hypothetical farms to show how sector averaging might work. Current nitrogen losses for each farm, the average nitrogen loss for all ten farms, and the average associated with a 51% reduction are displayed. The example shows that for farms with relatively high nitrogen losses, the reduction required may be much more than just 51%. For example, Farm G would be required to reduce nitrogen losses by over 70%.

In contrast, the example shows that farms with relatively low nitrogen losses (Farms A, B and D) do not need to change current operations and landowners may be able to sell surplus allowances or intensify land use.

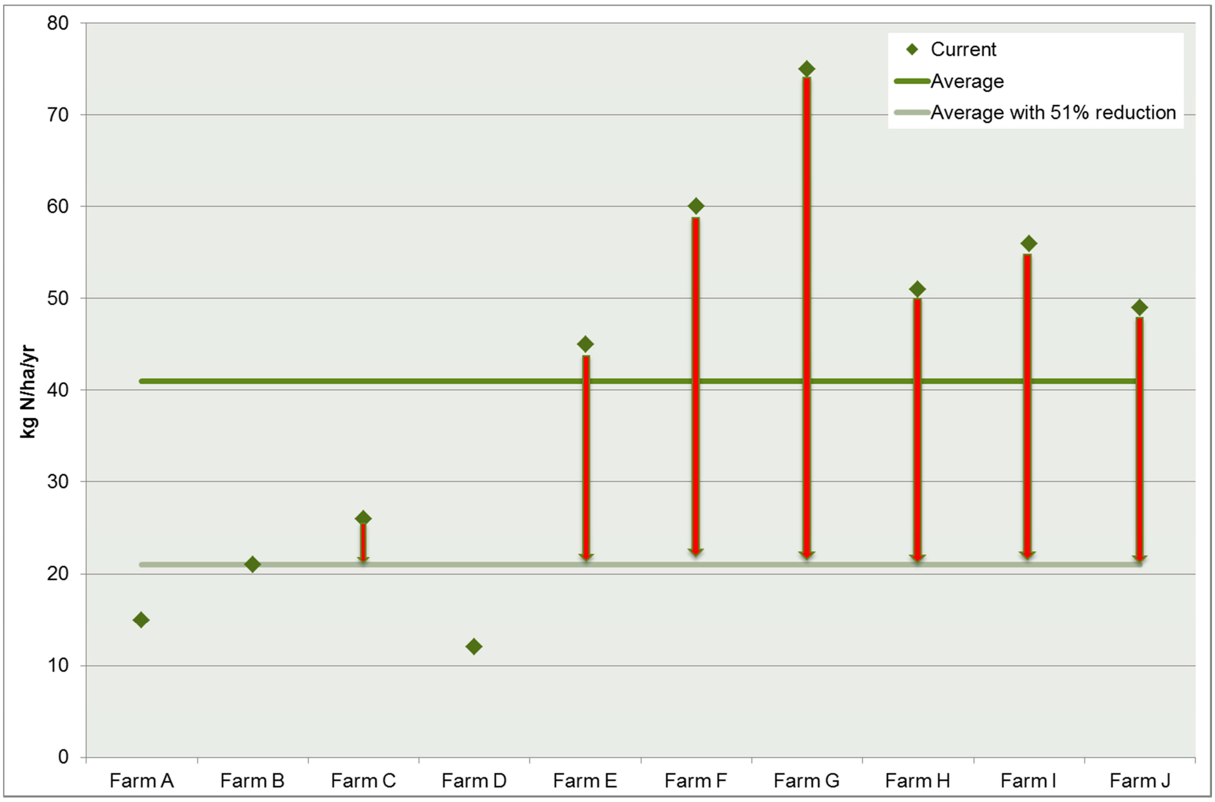


Figure 1: Reduction required from ten hypothetical farms when allocating using a sector average approach, with a 51% reduction applied to the sector average.

To an extent, sector averaging recognises current land use, investment and management techniques that reduce leaching rates. However, every farm is different and it is impractical to say that every hectare of land of the same land use will discharge the same amount of nitrogen (e.g. dairy with high (>2000mm) and low rainfall). In effect, this approach applies a polluter pays principle. Those land owners who are contributing most to water quality problems through intensity of land use and or poor natural capacity need to find ways to reduce their nitrogen loss.

Defining sectors and associated averages

To allocate nitrogen using a sector average approach, sectors must be specifically defined, as well as their associated average nitrogen losses.

Staff have identified that ROTAN estimated land uses and associated nitrogen losses are the most appropriate to be used to define sectors and their averages for the purpose of this allocation option (see the detailed analysis in Appendix D, including reasoning behind the definition of 'sectors' and as well as reasoning behind the allocation allowance proposed).

Rule 11 benchmark figures are more precise as they are the result of a process to measure nitrogen loss through Overseer. However, it is the ROTAN figures that have been used to derive the total nitrogen inputs in the catchment and that support the lake modelling that has been key in defining sustainable limits.

The proposed sectors, sector averages, and associated allocation allowances are therefore:

Sector	Sector average (ROTAN)	Allocation allowance (51% reduction)
Dairy	54.1	26.5
Drystock	15.7	7.7

It is noted that due to various rounding figures, that the proposed allocation of 26.5 kg N/ha to the dairy sector and 7.7 kg N/ha to the drystock sector results in a total pastoral loss of 258t rather than 256t. It is difficult to provide estimates with a level of accuracy that achieves the target precisely. In this case, 258t is less than 1% variation to the target which would be well within the error margin of the lakes model.

There are many ways in which allowances might be allocated to the sectors. For the sake of simplicity, the proposed allowances proportionately reduce the current sector average by 51%. Table 3 provides examples of different variations that could also be considered. These will result in disproportionate reductions to the sectors. For example a 20 kg N/ha allowance to dairy and a 10 kg N/ha allowance to drystock is a 63% reduction in the dairy sector average and a 36% reduction in the drystock sector average.

Council could choose to allocate alternative allowances based on an alternative method to those proposed by staff.

Table 3: Potential variations in the way allowances could be allocated to sectors. The allowances proposed in this paper are highlighted in bold.

Dairy allowance	Drystock allowance	Total pastoral N loss	Variance from target	Proportional reduction (dairy%:drystock%)
12	12	254.1	<1%	78:24
20	10	262.3	2.5%	63:36
25	8	255.3	<1%	54:49
26.5	**7.7**	**258**	**<1%**	**51:51**
27	8	265.4	3.7%	50:49
28[7]	11	318.8	24.5%	48:30
35[8]	13	386.4	50.9%	35:17

Implications for the Lake Rotorua catchment

Staff have analysed the data available from benchmarked properties in the Lake Rotorua catchment to understand how the proposed allowances will impact dairy and drystock farmers under a sector averaging approach. Figures 2 and 3 show the distribution of nitrogen losses on dairy and drystock farms (as at 2001-04) and where the proposed sector allowances sit in relation to these losses.

For dairy farms in the catchment, all but one farm have benchmarks higher than the proposed sector allowance (and the farm sitting in the 15-20 kg N/ha/yr range is an anomaly and not considered to be reflective of the sector). Figure 2 shows that reductions from benchmarks of about 45% will be required on average but may be as high as 65%. Eight farms would be required to reduce losses by over 51% - more than the catchment reduction required.

[7] Potential low N-loss farms as identified by expert panel with infrastructure and land use change
[8] Potential low N-loss farms as identified by expert panel without infrastructure and land use change

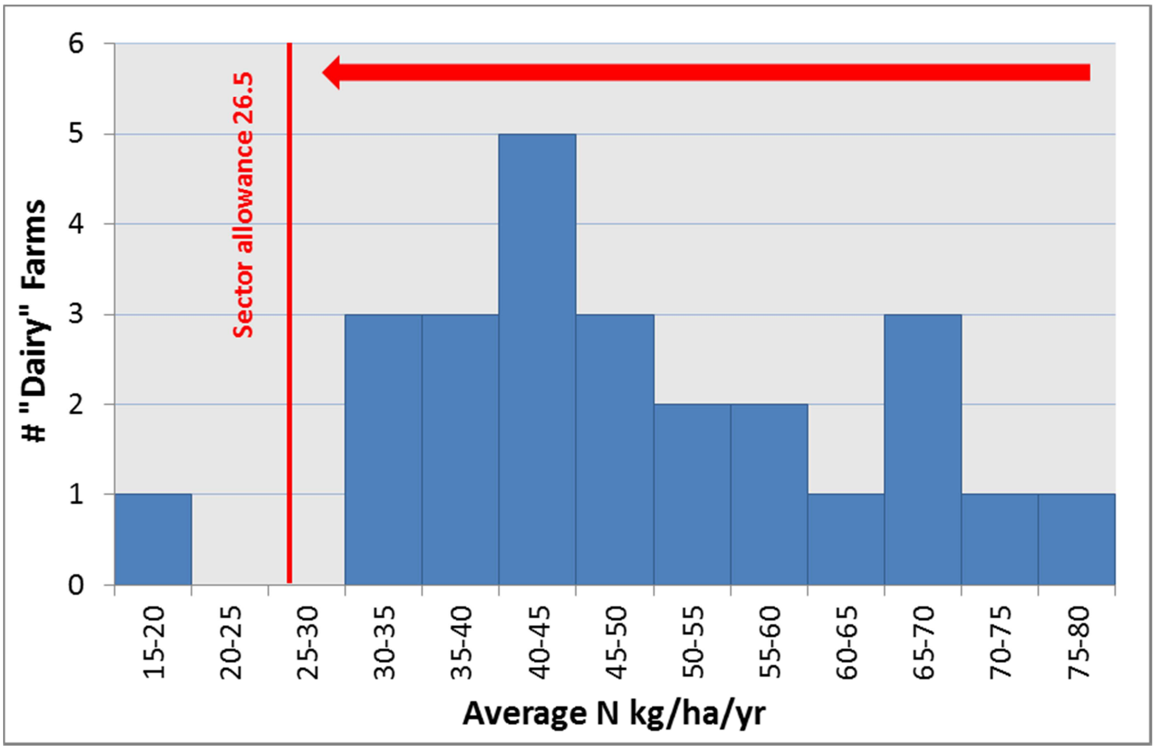


Figure 2: Range of nitrogen losses for dairy farms from the 2001-04 benchmarking data. The proposed sector allowance is marked in red; the arrow indicates that all farms with nitrogen losses to the right of this line will have to reduce discharges.

For drystock farms, there are a small number of farms with benchmarks below the proposed sector allowance. However, these benchmarks are low because most of the property is in trees, or bush and scrub. Figure 3 shows that the majority of farms have benchmarks in the range of 10-15 kg N/ha/yr so for these farms, nitrogen losses would need to effectively be halved. There are also a number of farms that would need to reduce nitrogen losses by over 75%.

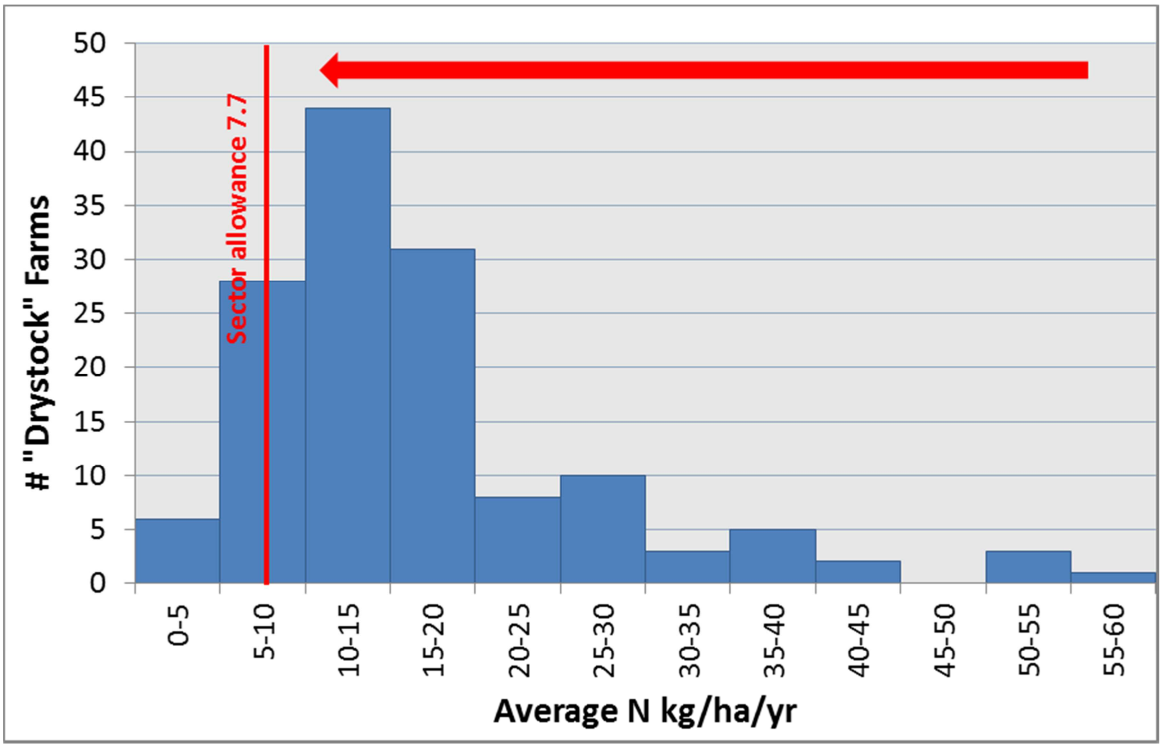


Figure 3: Range of nitrogen losses for drystock farms from the 2001-04 benchmarking data. The proposed sector allowance is marked in red; the arrow indicates that all farms with nitrogen losses to the right of this line will have to reduce discharges.

Nitrogen losses of 26.5 kg N/ha/yr for the dairy sector, and 7.7 kg N/ha/yr for the drystock sector is at the extreme low end of current nitrogen losses for both sectors. In addition, no dairy support (considered drystock for the purposes of this allocation method) is currently benchmarked as low as 8kg N/ha/yr.

An expert panel was convened to inform policy development on nitrogen allocation and its potential impacts. The panel explored the possible lower limit of nitrogen losses on dairy and sheep and beef farms while maintaining farm viability.

The information provided by the expert panel indicated that a "low" nitrogen loss dairy farm could conceivably operate at around 35 kg/ha/yr, or 28 kg/ha/yr if substantial investment was made in infrastructure such as a wintering barn. For sheep and beef, a "low' nitrogen loss farm might be able to operate at 13 kg/ha/yr, or 11 kg/ha/yr if half the property was converted to agro-forestry.

On paper, farm viability could potentially be retained (albeit at a reduced cash surplus, particularly for drystock) at these levels of nitrogen loss. In reality, however, different debt levels will mean it could be extremely difficult for some farms to lower nitrogen losses to these levels.

The proposed sector allowances are smaller than the potential lower limits explored by the expert panel. For the dairy sector, the proposed allowances may be achievable given some significant changes in management practice and potentially the purchase of additional nitrogen allowances.

The drystock sector has fewer opportunities to lower their nitrogen losses and it is likely that a sector allowance of 7 or 8 kgN/ha/yr will result in large scale land use change across the catchment.

Potential advantages of the sector average approach

- Some low leaching land uses may not be required to substantively change their management or uses
- Where nitrogen loss of an individual property is less than the allowance allocated, landowners could intensify or sell surplus (although there will be very few farms in this situation initially)
- May benefit less developed land that has had limited initial infrastructure investment. This is because current nitrogen losses may be closer to the sector-average and large scale change will not be required
- Could reward past mitigation and more sustainable farming practices – where farms are operating close to the nitrogen discharge allowance they will have more flexibility for land use options.
- A simple unmodified sector average (for single use properties) is straightforward and easy to understand
- More even-handed within the sector as the expectations for each farm are the same

Potential disadvantages of the sector average approach

- Does not account for variability between soil leaching rates, rainfall and other geophysical characteristics outside the control of landowners which can influence nitrogen leaching rates
- For those that have already mitigated, it might be harder to lower nitrogen losses any further as any further reductions in nitrogen loss are likely to be the most expensive

- Could hit the drystock sector hard as it allows no provision for things like dairy support which can be an important part of business sustainability
- Impacts on some farms will be disproportionately higher than impacts on other farms
- Doesn't recognise past investment in infrastructure
- Doesn't maximise action that could be taken by those on soils with lower leaching rates
- Risk of perverse effects for phosphorous loss if intensive use prioritised to poor draining soils
- Large scale of reduction (and therefore high costs) for high nitrogen loss properties
- Administratively complex as most properties have multiple land uses
- No provision for forestry or undeveloped land to be intensified

4.2 Option Two: grandparenting

Grandparenting allocates nitrogen allowances based on current (or a specified benchmark year) discharges, and includes any proportional reduction that may be required to achieve targets.

Figure 4 uses the example of the ten hypothetical farms from Figure 1 to show the reduction required from current nitrogen loss under a grandparenting approach. This is in contrast to those same farms under a sector average approach, where farms reduce disproportionately and in some cases, no reduction is required at all.

In this example, all farms must reduce proportionately. For farms with nitrogen losses that are higher than average this means less of a reduction is required than under the sector average example. For those farms with nitrogen losses that are lower than average, they are required to reduce regardless.

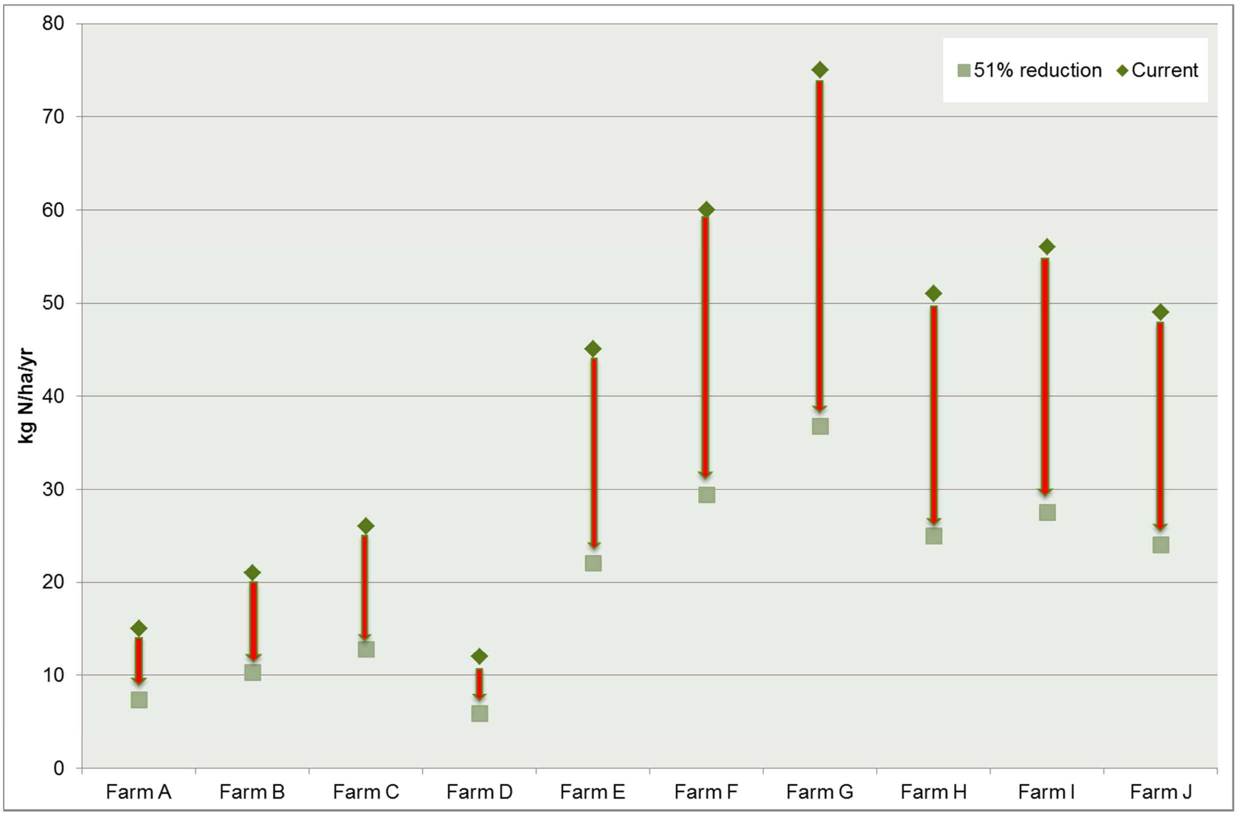


Figure 4: Reduction required from ten hypothetical farms when allocating using a grandparenting approach, with a 51% reduction applied proportionately across all farms.

Implications for the Lake Rotorua catchment

For the purposes of this report, grandparenting is based on existing discharges as determined by Rule 11 2001-04 benchmarking. To achieve the nitrogen target for Lake Rotorua, the current estimated loss from pastoral land needs to be reduced from 526 to 256 tonnes, which is a reduction of 51%. Under this approach, the reduction of 51% would apply to all landowners, regardless of how high or low current discharges are for individual properties.

For farms with nitrogen losses that are higher than average this means less of a reduction is required than under the sector average example. For those farms with nitrogen losses that are lower than average, they are required to reduce regardless. This is in contrast to those same farms under a sector average approach, where farms reduce disproportionately and in some cases, no reduction is required at all.

The Rule 11 benchmarking data shows that, for dairy farms, nitrogen losses are in the range of 15-20 to 75-80 kg/ha/yr (Figure 4). Most farm benchmarks for dairy are in the range of 40-45 kg N/ha/yr. If all farms are required to reduce benchmarks by 51%, the spread across farms will become much narrower, in the range of 5-10 to 35-40 kg N/ha/yr.

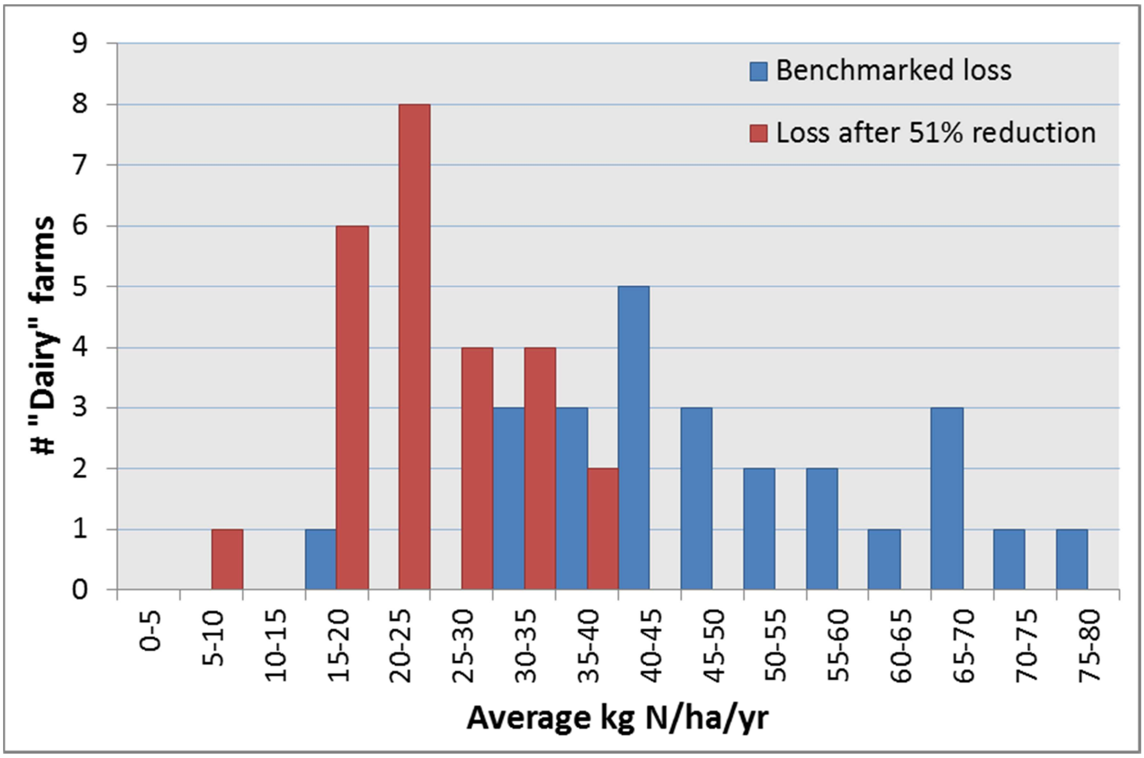


Figure 4: Changes in the range of nitrogen losses for dairy farms as a result of allocating allowances at 51% of current loss. The 2001-04 benchmarking data is shown in blue; ranges after a 51% reduction are shown in red.

The benchmarking data from Rule 11 shows that the range of benchmarks for drystock farms is much broader than for dairy farms (Figure 5), ranging from 0-5 kg N/ha/yr to 55-60 kg N/ha/yr. However, most farm benchmarks are in the range of 10-15 kg N/ha/yr. If all farms are required to reduce benchmarks by 51%, the spread across drystock farms is much reduced from 0-5 to 25-30 kg N/ha/yr.

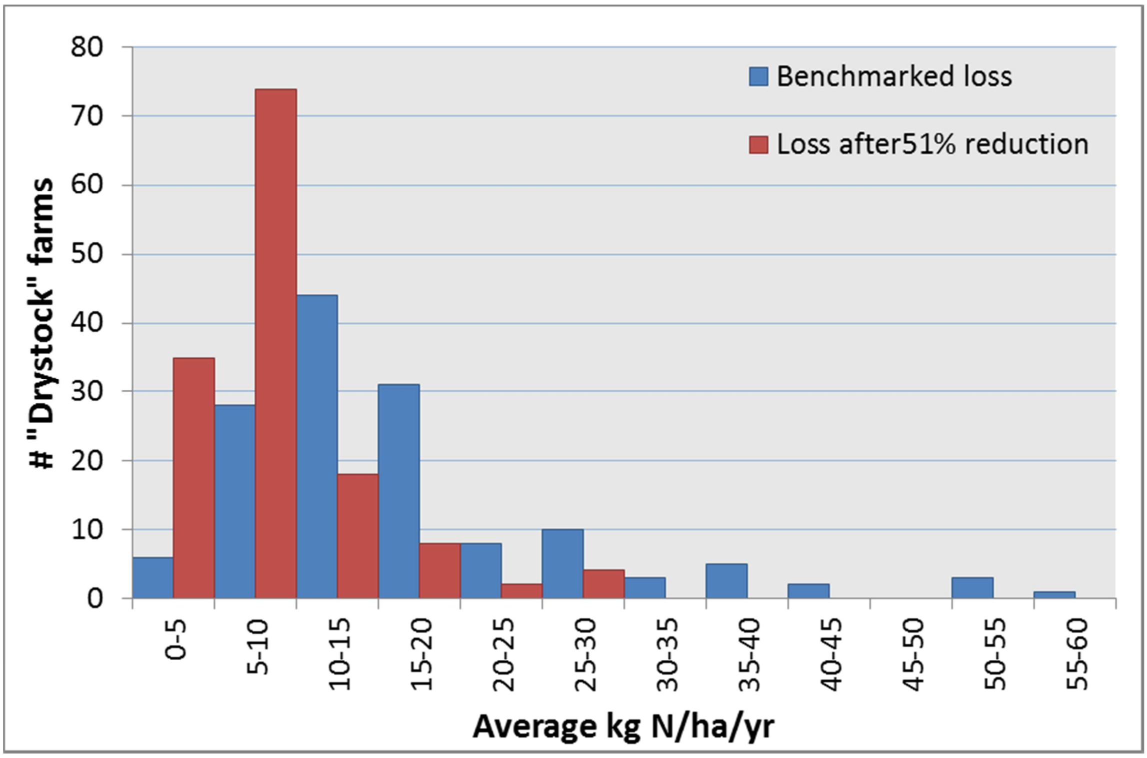


Figure 5: Changes in the range of nitrogen losses for drystock farms as a result of allocating allowances at 51% of current loss. The 2001-04 benchmarking data is shown in blue; ranges after a 51% reduction are shown in red.

Applying a grandparenting allocation approach will have significant negative impacts on those properties at the very low end of the nitrogen loss range. It is assumed that many of these properties have already made substantive efforts to reduce their nitrogen losses and cannot reduce any further. The only way these properties could continue to operate would be to change land use entirely, or purchase additional allowances if they become available through a trading scheme.

As previously mentioned, the information provided by the expert panel indicated that a "low" nitrogen loss dairy farm could conceivably operate at around 35 kg/ha/yr, or 28 kg/ha/yr if substantial investment was made in infrastructure such as a wintering barn. For sheep and beef, a "low' nitrogen loss farm might be able to operate at 13 kg/ha/yr, or 11 kg/ha/yr if half the property was converted to agro-forestry.

Given the uncertain profitability associated with the expert panel estimates, a 51% reduction from already low nitrogen loss properties will be hard to achieve. Essentially this approach penalises those with little room to move or improve and could force them out of their current land use.

How the grandparenting approach will impact on those with very high nitrogen losses will depend on the reasons why the leaching rates are high in the first place. If it is due to geophysical factors such as rainfall or soil type, this approach will provide a level of relief by providing an allowance that is higher than a property that isn't impacted by the same geophysical factors. Landowners will still need to further invest in mitigation or purchase additional nitrogen allowances from a willing seller.

If however, a particular property has high nitrogen losses because there has been little mitigation in place, this approach will provide a potential benefit to the landowner. A higher nitrogen allowance will be awarded that could potentially be met, at least in part, by relatively simple and cheap mitigations.

Potential advantages of the grandparenting approach

- Every land owner has to reduce their nitrogen loss proportionally

- Recognises existing capital expenditure
- Farmers who have high rates of baseline nitrogen loss, or higher mitigation costs, due to factors outside their control are not disadvantaged
- There are limited opportunities for windfall gains as no individuals will receive allowances they do not need
- Larger allowances given to high nitrogen loss properties may provide more scope to undertake more capital intensive mitigation, particularly if incentive funding is available
- Administratively simple because there is one benchmark per property, even if there are multiple land uses on that property.

Potential disadvantages of the grandparenting approach

- Does not recognise mitigation that has already been undertaken and expects all landowners to mitigate proportionally
- Gives a preference to high nitrogen losses over low nitrogen losses
- Those that have already made significant reductions will receive very low allowances - penalising any early actions to mitigate nitrogen loss
- Rewards individuals that haven't improved practices to reduce nitrogen loss, potentially providing an allowance that is still higher than what might be considered good management practice
- Places a large reliance on the accuracy and relevance of Rule 11 benchmarking when the quantity and quality of farm documentation varies considerably from farm to farm
- May be administratively difficult for those properties below 40ha that have not yet been benchmarked. The intent is to provide a default benchmark for these properties based on predominant land use, but this will be challenged if it translates into a nitrogen allowance that has a market value.

4.3 Comparison of options

Ultimately, the two allocation options have the same impact across the catchment. This is because both will achieve a catchment wide reduction from 526 tN/yr to 256 tN/yr. However, the way in which the costs are spread is very different under each approach. This is simplified in the table below:

Farm	N-loss	N allowance under sector averaging	N allowance under grandparenting
Farm 1	10	10	5
Farm 2	20	10	10
Farm 3	30	10	15
TOTAL	60	30	30

Both sector averaging and grandparenting include a proportional reduction in nitrogen loss to achieve the sustainable limit. Under sector averaging, Farm 1 which has a relatively low nitrogen loss can continue with current operations and therefore incur no impact. However, under a grandparenting allocation, that same farm would be required to reduce nitrogen loss by half. On the other hand, Farm 3 that has high nitrogen loss is required to reduce their loss under both allocation approaches. However the required reduction is less under grandparenting and therefore costs would be lower under this approach.

On balance, more dairy and drystock farmers in the Rotorua catchment will receive a higher allowance under the sector average approach than the grandparenting approach. For dairy farms, a grandparenting allocation approach will mean 8 of the 25 benchmarked farms will receive a **higher** allowance than they would have under the proposed sector allowance of 26.5 kg N/ha/yr. Conversely, a grandparenting allocation approach will mean 17 of the 25 benchmarked farms will receive a **lower** allowance than they would have under the proposed sector allowance of 26.5 kg N/ha/yr.

For drystock farms in the Rotorua catchment, a grandparenting allocation approach will mean 57 of the 141 benchmarked farms will receive a **higher** allowance than they would have under the proposed sector allowance of 7.7 kg N/ha/yr. Conversely, a grandparenting allocation approach will mean 84 of the 141 benchmarked farms will receive a **lower** allowance than they would have under the proposed sector allowance of 7.7 kg N/ha/yr.

An analysis of the preference determinants for each allocation option is provided in Appendix E. Likely characteristics of the types of farms that will prefer a grandparenting approach are:

- high nitrogen loss; or
- more intensive practices; or
- higher rainfall; or
- performed little mitigation

Likely characteristics of the types of farms that will prefer a sector averaging approach are:

- low nitrogen loss; or
- less intensive practices; or
- lower rainfall; or
- already undertaken some degree of mitigation.

Comparative impact modelling

Staff commissioned Mōtū Economic and Public Policy Research to use their own model (NManager) to assess the impact of each allocation method on the dairy and drystock sectors. The full report is available on request.

It is important to note that Mōtū assumed that a trading scheme for nitrogen would be in place as part of the allocation framework. Further, the actual figures generated are based on other assumptions that impact the quantitative results. The usefulness of the modelling is in its qualitative findings. i.e. the pattern and trends of economic impacts.

The key findings from Mōtū's analysis are:

- Farmers with low baseline leaching are unequivocally better off under a sector based approach, and farmers whose nitrogen losses are higher than the sectors average are better off under a grandparenting allocation
- Most of the reduction in nitrogen loss is provided by dry stock farmers and more than half are projected (under the model) to fully convert to forestry use
- The drystock sector faces higher total mitigation costs than the dairy sector. However, by performing this mitigation, dry stock farmers are able to sell valuable allowances to dairy farmers. The revenue from the sale of allowances largely offsets their cost of mitigation
- Dairy farmers are better off by purchasing allowances from outside the sector (i.e. by paying dry stock farmers to perform mitigation for them). Because of this demand for additional allowances, the total cost to the dairy sector is higher (both per hectare and overall)

- The grandparenting approach leads to more equal cost sharing within the dairy sector (i.e. it is associated with a narrower range of impacts). More dairy farmers are better off under a grandparenting approach than they are under a sector average approach
- For the drystock sector, it is not clear that the grandparenting approach leads to more equal cost sharing and in fact a much larger proportion of drystock farmers are better off under a sector average approach
- The relative impact of choosing either allocation system diminishes over time and as trading takes place

The estimated distribution of **total** costs for individuals (**mitigation** + **purchase** of additional nitrogen allowances) under both allocation approaches are demonstrated in the figures below for the dairy sector (Figure 6) and the drystock sector (Figure 7)

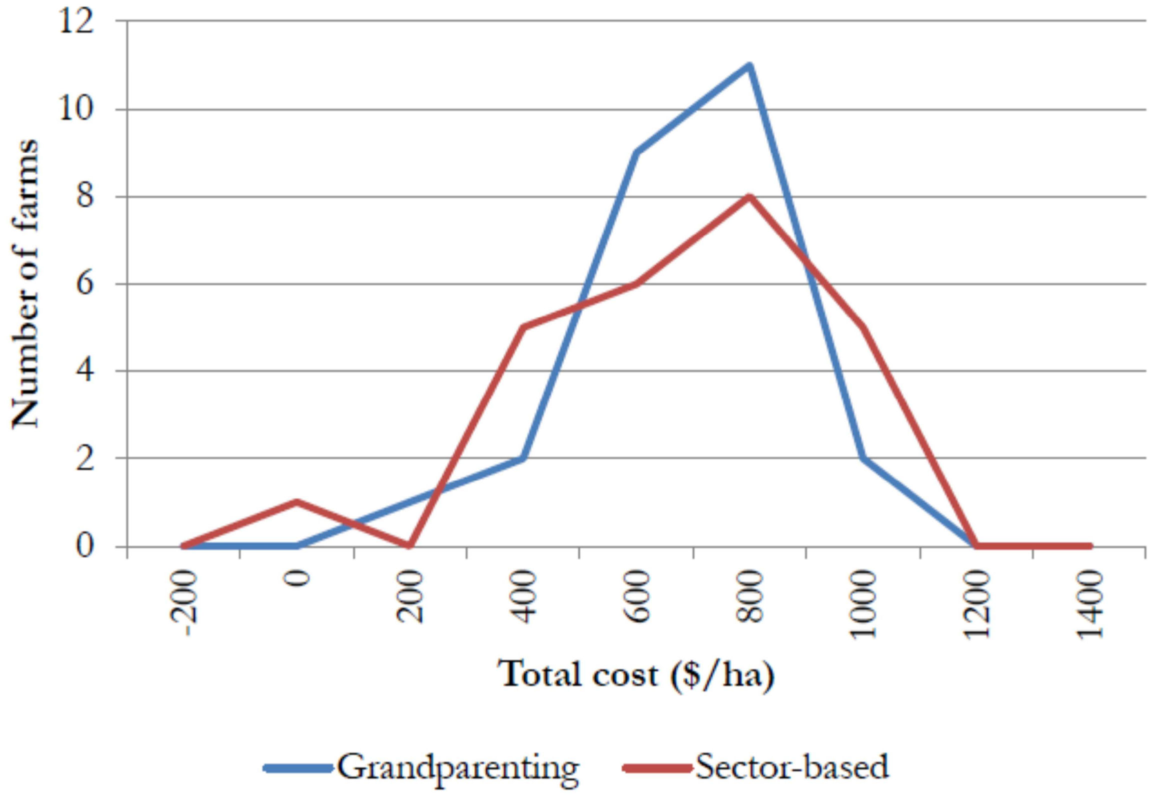


Figure 6: Distribution of total costs for individuals in the dairy sector

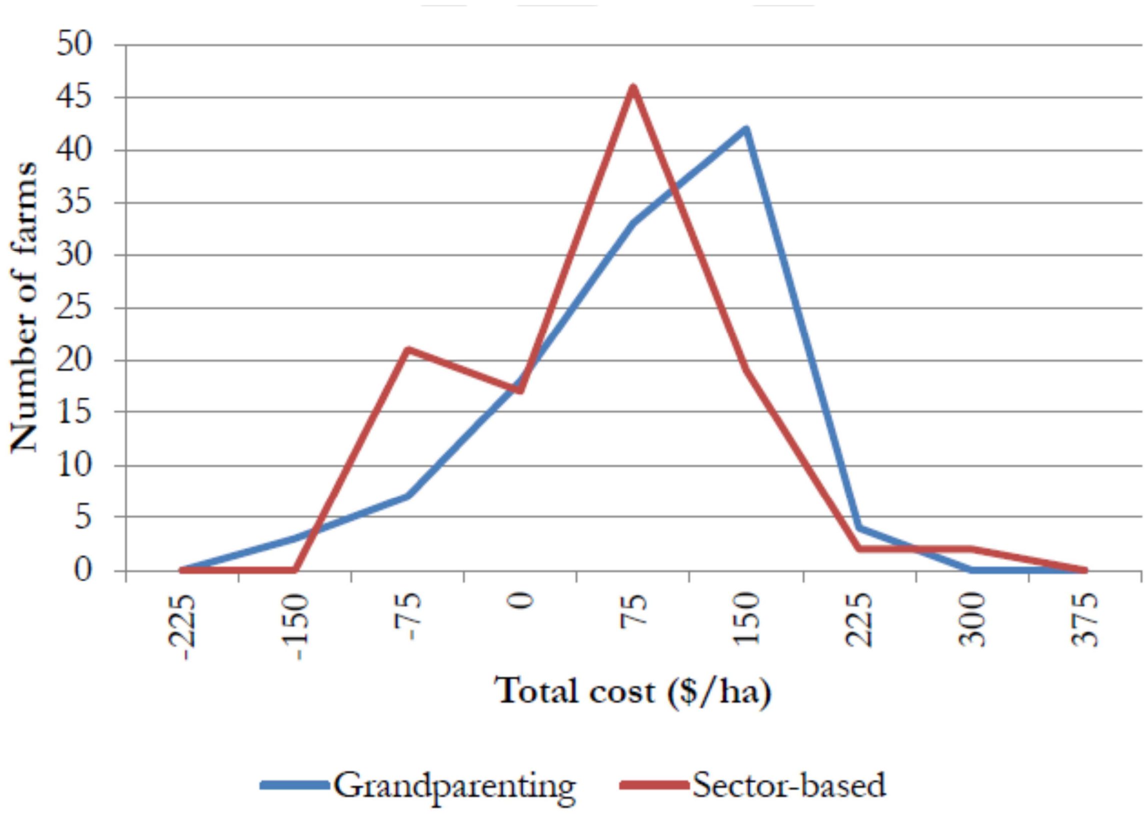


Figure 7: Distribution of total costs for individuals in the drystock sector

Issues around costs

The cost of meeting the nitrogen target for the lake is high. The broad array of costs associated with achieving the sustainable limit has been identified in this report (section 2.3). However, there are specific issues around costs associated with allocating nitrogen in the catchment and Council needs to understand the significance of what is being proposed. These include:

- The costs associated with the continued operation of any pastoral farm in the Rotorua catchment will not just be a result of land management or land use change. Given the very low allowances that will be provided under either allocation approach, most landowners will also be required to purchase additional nitrogen allowances from a willing seller
- Motu simulations suggest that meeting the final target requires the conversion to forestry of many dry stock farms, and the implementation of farm management techniques that could be labelled 'best practice' on most dairy farms. For dairy, total costs may be as high as $1200/ha. For drystock total costs may be as high as $400/ha
- There is an assumption that land use change to forestry will occur to some extent on most drystock farms in the catchment. However, the Farmers Solutions Project identified significant resistance amongst landowners, regardless of the business case for profitability. Most farmers want to continue farming animals, not trees. Further, plantation trees result in lumpy and delayed income which makes it difficult for people to manage
- The Farmer Solutions Project also identified the potential risk for capital depreciation of land within the Lake Rotorua catchment as a result of any policies that result in NDAs having tangible economic value, such as through trading.

5.0 Summary of options analysis

The impact of potential change cannot be understated. The scale of reduction required, particularly for the pastoral sector, means that these overall impacts will occur regardless of the allocation approach that Council chooses to implement, although the approach chosen will impact relative “winners” and “losers”.

This report has outlined the potential economic impacts of achieving the sustainable limit. The Farmer Solutions Project has conservatively estimated the cost of delivering a 240tN/yr reduction[9] at a farm gate cost of around $88 million. The follow on effects to the catchment and regional economy will be significant.

At a catchment scale, total mitigation costs will be the same for both allocation approaches because we need to arrive at the same end point (nitrogen target of 435tN/ha/yr). However both allocation approaches will affect individuals differently.

There is no ‘right way’ to allocate allowances as there is no generally agreed upon definition of how cost should be fairly shared amongst individuals or sectors. The best allocation system will be the one that the community agrees is fair and politically acceptable.

Staff have outlined the scale of impact and identified who will be affected by each allocation method and to what degree. Choosing an allocation method is a political decision. Ultimately, this decision will decide who will be impacted the most.

Council may choose to address unfavourable aspects of either approach by developing a hybrid allocation model. Again, the choice becomes political as it will determine who will be impacted the most. Potential hybrids are discussed below.

5.1 Potential hybrid models

It is important to keep in mind that addressing one inequity can result in creating another inequity. The nitrogen limit is fixed and cannot be increased. By trying to give one group of farmers (or a sector) a higher allocation, it inevitably means everyone else has to have a lower allocation.

However, Council may choose to change aspects of its preferred approach to deal specifically with perceived inequities.

If **sector averaging** is Council’s preferred approach, modifications to the model could be made such as:

- Including a cap on any landowners that are operating below the sector average. For example, if a dairy farmer is operating at 20 kg N/ha/yr but the sector average is 26.5 kg N/ha/yr, that farmer would only receive a 20kg allowance. This would ensure there are no potential gains can be made through the allocation process. This might be considered a fairer approach given impacts overall are likely to be significant. [*Note - this will mean there will be some “additional” allowances in the system*].
- Adjusting the proposed sector average allowances. For example, given the drystock average is so low that it is likely to result in a significant loss of drystock farming in the catchment, Council could choose to adjust the drystock sector average and make it slightly higher (e.g. provide an allowance of 10 not 7.7 kg N/ha/yr). [*Note - this would lessen the impacts on the sector but would come at the expense of the dairy sector which would need to go down to 20 kg N/ha/yr*].

[9] Note the Farmers Solutions Project assesses costs of delivering a 240 tN/yr reduction, not a 270 tN/yr reduction

If **grandparenting** is Council's preferred approach, modifications to the model could be made such as:

- Not requiring very low nitrogen loss properties to reduce any further. For example any dairy farms operating below 30 kg N/ha/yr or drystock farms operating below 10 kg N/ha/yr would not be required to reduce by 51%. [*Note – this would come at the direct expense of all other farms in the catchment, and would be very hard to determine the most appropriate 'bottom line'*].
- Require a best management practice bottom line so that where an allowance might still be very high, it would not be higher than what we expect best management practice to look like. For example, if a drystock farmer had a benchmark of 40 kg N/ha/yr and would receive an allocation allowance of 20 kg N/ha/yr, Council could require that they receive no more than 14 kg N/ha/yr. [*Note – this would require a definition of 'best practice' for both dairy and drystock sectors. It may result in some "additional" allowances in the system*].

8.0 Further issues for consideration

There are issues related to land use, land ownership and nitrogen losses in the catchment that Council needs to be aware of. These issues do not affect choices around the way in which nitrogen losses are allocated, but they do need to be considered in the broader context of Rotorua's water and land management.

8.1 Gorse

Studies have shown that gorse stands leach nitrates into groundwater, through fixing and accumulating nitrogen in the root systems. Leaching rates are variable, but have been estimated at between 24 and 64kg N/ha/yr.

Recent analysis and review suggests that for the Lake Rotorua catchment, a conservative estimate of 38kg N/ha/yr should be used in calculating nitrogen leaching associated with gorse. There is approximately 870 ha of gorse in the Rotorua catchment, indicating that gorse could be leaching up to 33 tonnes N/yr.

While nitrogen leaching associated with gorse is recognised as a problem, it is not specifically identified in the tools used for modelling (ROTAN) and measuring (Overseer) nitrogen loss.

ROTAN is the model used to assess nitrogen loads in the Rotorua catchment, providing information on predicted nitrogen yields and exports. Exports are based on estimated yields from different land use types[10], including pastoral land use, urban land use and forest. ROTAN does not explicitly model nitrogen exports from gorse in the catchment for number of reasons including:

- gorse is associated with different land uses, it is not considered to be a land use on its own that would be modelled and reported on over time

- the total nitrogen loss associated with gorse is minor (<5%) relative to the total catchment load of 755 tonnes N/yr. This could be considered within the error margins of the model.

Despite not being explicitly modelled, leaching from gorse is accounted for in ROTAN through forest and pastoral yields, and through calibration of the model. That is, the total catchment load of 755 tonnes N/yr includes nitrogen loss from gorse.

Overseer has been used calculate the total nutrient discharge allowance (NDA) for most large properties in Rule 11 catchments. The benchmarks do not include provisions for nitrogen loss associated with gorse.

[10] For example, the 'current' (2003-2009) nitrogen yield from dairy farms was estimated at an average of 56 kg N/ha/yr, and from drystock farms was estimated at an average of 16 kg N/ha/yr.

This decision was made for a number of reasons, including not wanting to incentivise poor land management.

For benchmarking purposes gorse cover is captured as "bush and scrub" with an average discharge of 3kg N/ha. This is significantly lower than the potential gorse nitrogen loss of 38kg N/ha. Because of this, removing gorse on an individual property will not be measured as a nitrogen loss reduction against a benchmark. Further, where lower NDAs are issued as part of the proposed allocation process, removing gorse on an individual property will not be recognised as helping that landowner meet the new NDA.

Despite these issues, it is clear that removing gorse in the catchment will help to achieve long term improvements in the water quality of the lake. A 270 tonne/yr reduction in nitrogen loss is required from pastoral land use activities in order to achieve the sustainable nitrogen limit of 435 tonnes/yr. Staff are confident that gorse removal could achieve up to 30 tonnes of this 270 tonne reduction.

In recognition of the impact gorse can have on water quality, a position statement for gorse in the Lakes Catchments was approved by Council on 25 June 2013:

> *Council support for land use change on gorse infested land will be considered where gorse affects water quality and land use change is to a nitrogen discharge level of no more than 4kg/ha/yr*

This position statement enables Council to support land use change on gorse infested land, where the new use is at or below 4kg/N/ha/ year. Staff are working on a project plan to support Councils position.

To prevent further infestations of gorse in the catchment, the rules that will be developed to support allocation will need to ensure that gorse is fully accounted for on all properties in the future.

8.2 Māori owned Land

Māori have a distinctive role in water catchments as tangata whenua, but also fill many other, potentially conflicting, roles: small and large pastoral landowners, forest owners and water users. These various roles bring about a number of issues that Māori landowners will face under any regulation to improve water quality.

Māori land makes up approximately 25% of the catchment (see Figure 8). Land use on Māori land is similar to land use on non-Māori land in the catchment, although there is a much higher proportion of Māori land in 'bush' (see Table 4 below).

Table 4: Land use on Māori land in the Lake Rotorua catchment

Land use	% Māori land	% non-Māori land	% all land
Bush	33	20	24
Cropping	1	1	1
Dairy	10	12	11
Drystock	37	34	35
Plantation	16	18	17
Other	3	16	12

Experience in the Rotorua catchment has suggested that Maori land is on average less developed than non-Maori land; that is, it has lower production intensity (and nutrient leaching rates) than the lands potential. Reasons for this include the unique ownership, decision making, and funding difficulties that stem from the cooperative ownership restrictions on Maori land as a result of the Te Ture Whenua Maori Act 1993.

This land was under-developed at the time of Rule 11 due to management restrictions, limited investment funds and a conscious decision to minimise the impact on the lake. This lower level of development has serious implications for Maori land owners if regulation restricts nutrient discharges to a rate proportional to current discharges (grandparenting). They may be better off under sector based averaging especially if gorse areas are incentivised to be planted to trees.

8.3 Risks and Limitations

The change required from pastoral farmers in the Rotorua catchment is significant. Whatever allocation approach is agreed, there are a variety of risks associated with requiring this change that Council need to be aware of. These could include, but are not limited to:

- Adverse effects to the catchment's landscape, such as extensive pine tree plantations that impact on the rural nature of the catchment
- Less diverse farm systems due to an extremely low cap in place that doesn't allow diversification
- Restrictive regulation can undermine the ethic of stewardship as landowners feel that ultimate responsibility does not lie with them
- Farmers could be locked in to an allowance that is too high to reach the lake's sustainable limit, or lower than what might be required
- Insufficient financial capacity of farmers and farm advisors to implement the required change
- No demand for lower leaching land uses like lifestyle and forestry
- Fluctuating prices (eg for carbon or nitrogen allowances) giving additional uncertainty to farmers already dealing with changing market prices and changing input costs
- Farmer reluctance to comply with what may be seen as overly 'harsh' regulations

9.0 Next steps

The decision to agree on a preferred allocation option is a decision in-principle. Once staff have a clear direction on the preferred option, the rules and implementation framework to support this option can be developed.

Key considerations for Council in implementation will include:

- *Giving effect to the 20 year implementation period in the Proposed RPS*. The Proposed RPS requires that no discharges shall be authorised beyond 2032 that result in the 435 tonne limit being exceeded, and that an intermediate target is to be set to achieve 70% of required reduction by 2022. How the allocation of nitrogen allowances are transitioned over this timeframe will need careful consideration.
- *Responding to changes in science.* Our understanding of the lake and its catchment continues to evolve, particularly the relationship between nitrogen and phosphorous and their effects on water quality. How we respond to changes in science through the implementation of this policy needs to be determined (e.g. if new science indicates the sustainable nitrogen limit is higher or lower than the current 435tN/yr).
- *Monitoring and compliance*. Any management regime that provides discharge allowances to individual properties will need to be supported by a robust monitoring and compliance programme.

Staff will seek direction regularly from Council as drafting of rules progresses. It is anticipated a draft plan change will be ready for wider community consultation by June 2014.

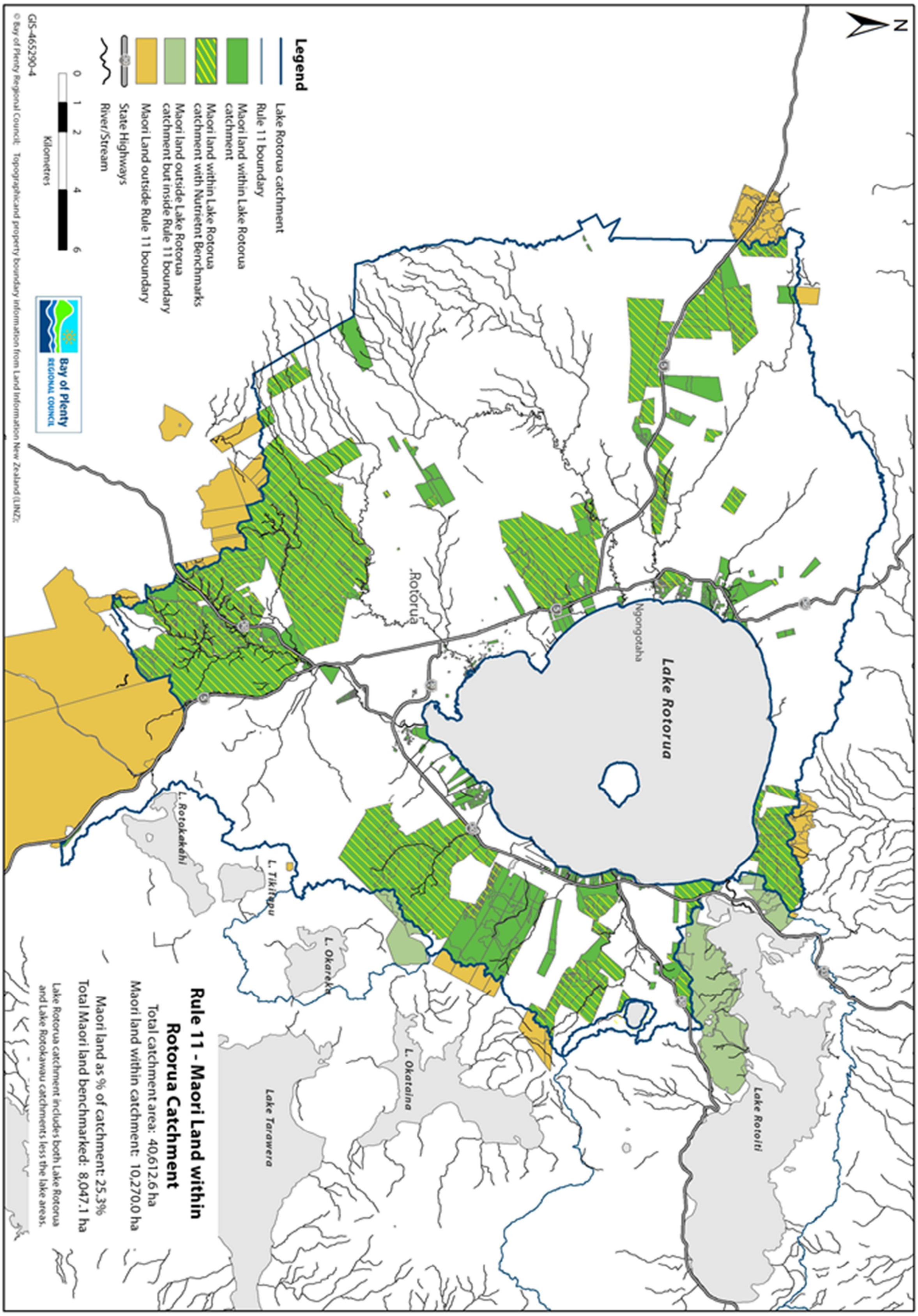


Figure 8: Map of Maori land within the Lake Rotorua catchment.

Appendix A: Assumptions and uncertainties in the lakes science and data

There are some inherent assumptions and uncertainties in the science and information used to determine the Trophic Level Index (TLI), sustainable limit, as well as current nitrogen inputs to the lake. It is important that these assumptions and uncertainties are well-understood and the risks associated with them are identified.

An overview of the assumptions and uncertainties are provided below.

Lake Rotorua's sustainable nitrogen limit and the TLI

A critical assumption in all of the policy and regulation related to Lake Rotorua's water quality is that:

a) the community's expectations have been adequately taken into account in the setting of all water quality limits; and
b) the community understand the costs and benefits associated with achieving their expectations.

The lake target of 435 tN/yr originated from meetings in 1986 involving scientists and engineers from the Taupō Research Laboratory, Hamilton Science Centre, Ministry of Works and Development, National Water and Soil Conservation Authority, Bay of Plenty Regional Council, Rotorua District Council, and several engineering consultants.

The target was developed in response to public complaints about regular algal blooms in the lake. Water quality in Lake Rotorua had steadily deteriorated from 1976 due to the discharge of city sewage into the lake which caused widespread public concern. The lake target that was set reflected the water quality that had been experienced in the 1960s, prior to sewage discharge.

This 'sustainable nitrogen limit' to achieve 1960's water quality was subsequently described and published in 1989[11]. When the Rotorua city treated wastewater discharge changed to include land treatment in 1990, water quality expectations for the lake were further specified in documents associated with the consent.

The sustainable nitrogen limit estimate has not subsequently changed since first identified in 1989.

The target TLI for Lake Rotorua of 4.2 was established in the Proposed Regional Water and Land Plan which was publicly notified in 2001. That the sustainable nitrogen limit of 435t N/yr corresponded with the target TLI was confirmed in 2003[12] and again in 2008[13].

The statutory consultation process for the Proposed Regional Water and Land Plan occurred between 2002 and 2004, and community views on Rotorua's TLI were sought at this time. Very few submissions were received (11 in total) and the TLI target of 4.2 became official when the Regional Water and Land Plan became operative in December 2008.

The community has had the opportunity to provide comment on Rotorua's TLI and sustainable nitrogen limit through consultation on various planning documents since that time, including:

- The Lake Rotorua and Rotoiti Action Plan
- The Proposed Regional Policy Statement

[11] Rutherford, J.C., Pridmore, R.D., White, E. (1989), Management of phosphorus and nitrogen inputs to Lake Rotorua, New Zealand, Journal of Water Resources Planning & Management 115 (4): 431-439.
[12] Rutherford, K., (2003), Lake Rotorua Nutrient Load Targets, NIWA Client Report: HAM2003-155.
[13] Rutherford, K. (2008), Nutrient load targets for Lake Rotorua - a revisit, NIWA Client Report: HAM2008-080.

- Ten Year Plans

No concerns have been raised about the TLI or the sustainable limit during these consultation processes.

Lake Rotorua's current TLI and the impact of phosphorous

In the 2011/12 monitoring year, the water quality of Lake Rotorua was the lowest it has been since monitoring began. The annual average TLI for 11/12 was 4.08, below the 4.2 target, although the three year average was reported as 4.4.

This TLI has been achieved despite the current nitrogen load being significantly more than the sustainable limit of 435t N/yr, and a significant trend of increasing nitrogen in most major inflows to the lake[14]. The 2012 TLI for the lake is likely to be due to two factors:

- A cold and windy summer in 2011/12 resulting in no stratification events in the lake
- Significant alum dosing in the Utuhina and Puarenga streams, removing approximately 20T of phosphorous from the system.

The contributions that both factors have made to water quality improvements are unclear at this stage. It is likely, however, that alum dosing through the two P-locking plants at Utuhina and Puarenga greatly improved water clarity in Lake Rotorua and strongly contributed to the annual TLI result.

More information is required to better understand the effects that alum dosing is having, and more importantly, the importance of phosphorous to water quality of the lake. Additional modelling of the relationship between nitrogen and phosphorous is now underway to determine whether different nitrogen and phosphorous load combinations could achieve the TLI of 4.2.

It is important to note that alum dosing was only ever intended as a short-term intervention, and the consent is only issued to 2018. The intervention carries significant risks, including:

- potential impacts on the lake's pH
- unknown sustainable loads of alum
- potential ecological impacts from long term applications of alum
- lack of long term community support.

The current scientific advice from the Water Quality Technical Advisory Group advice remains that to achieve a long-term TLI of 4.2, no more than 435 tonnes of nitrogen and 37 tonnes of phosphorous should enter the lake each year.

Modelling of nitrogen loads in the catchment

Modelling of nitrogen loads in the Rotorua catchment has used the Rotorua and Taupō Nutrient model (ROTAN). This is a geographic information system based catchment hydrology and water quality model developed by NIWA to predict nitrogen yields and exports in the catchment under different scenarios.

As discussed in Rutherford et al (2009) there is uncertainty in estimating lake loads and response times, arising from factors such as uncertainty in:

- Historic land use and in particular which areas were dairy and drystock
- Historic nitrogen export rates from each land use
- When land use and export rates changed
- Aquifer boundaries

[14] Bay of Plenty Regional Council (2013) Trends and state of nutrients in Lake Rotorua streams, Environmental Publication 2013/08 ISSN: 1175-9372 (Print), ISSN: 1179-9471 (Online).

- Aquifer parameters (including the proportions of total infiltration that enter the quickflow, slow flow and deep aquifers, and the volume, porosity and conductivity of those aquifers), which determine groundwater lag times
- Nitrogen attenuation

Staff also note there are uncertainties in some things used to inform the model like current land use and current exports from pasture, as some of this information was based on best estimates from expert discussion as opposed to measurements.

For example, ROTAN uses land use areas that have been extrapolated from GIS maps and best estimates and these don't necessarily correspond to land uses that have been identified through the benchmarking process.

While ROTAN is an excellent model, it is just a model and has been developed to provide estimates in lake loads rather than accurate values. Council needs to be aware of the risks of using these model estimates as the basis for a very precise allocation of nitrogen discharges to individual landowners in the catchment.

Data issues

Overseer limitations

OVERSEER© is the tool that Council uses to model nutrient losses at the farm scale for benchmarking purposes. OVERSEER® has benefits, but also has some limitations:

- Nearly all benchmarking in the Lake Rotorua catchment has been done using OVERSEER® 5 and its various versions. OVERSEER® 6 is now available and has been updated with improved soil drainage calculations which are relevant for the Rotorua catchment soils. Running the Rule 11 farm files through different OVERSEER® versions may generate different nitrogen leaching results. For Rotorua farms, OVERSEER® 6 is giving larger N leaching losses compared to OVERSEER 5.
- OVERSEER® estimates average annual N losses and therefore does not provide actual annual losses for a farm.
- There is only limited data available to validate the model. Therefore, the tool extrapolates the results to those soils and climates where OVERSEER® it has not tested. Lake Rotorua is one region where the OVERSEER® tool has not been validated.

Groundwater and surface water boundaries

The groundwater catchment boundary that is used in the ROTAN model is larger than the surface water catchment boundary used for most other council purposes (e.g. Rule 11). Unfortunately this means there is quite detailed information available for most of the groundwater catchment, but not all.

Staff are currently working on extending the detailed land use information currently available for the surface water catchment out to the groundwater boundary. This is being done through a combination of GIS mapping, survey work and groundtruthing.

Detailed land use information in the catchment

We have a good understanding of land use in the catchment where properties are greater than 40ha, or in forestry. This is because we have benchmarked properties of this size under Rule 11. However we have limited knowledge of how land is used on properties smaller than 40ha, particularly on 'lifestyle' blocks smaller than 15ha.

For the purposes of this policy paper, staff have extrapolated information that we know from the larger properties and assumed the average nitrogen losses will be the same regardless of property size. While this may be appropriate for a high level policy paper, a better understanding of land uses on all properties will be required to implement this policy.

Staff have commissioned work to investigate land use on properties smaller than 40ha and the results of this work are expected by September 2013.

Staff also note that the land use information that is available from the benchmarking work relates to land use in 2001-04. While the total nitrogen loss associated with each benchmarked property should not have increased since that time, this is unknown and land use may have changed with a resulting change in nitrogen loss. Again, this is fine for a high level policy paper but more up to date information will be required once the policy is implemented.

Appendix B: Planned interventions and associated costs for Lake Rotorua and its catchment

Table 5 sets out planned interventions and associated costs for Lake Rotorua and its catchment over the next ten years. Implementation of the interventions listed sits with either the Bay of Plenty Regional Council or Rotorua District Council (community wastewater reticulation). Under the Funding Deed with the Crown (Minister for the Environment), the Bay of Plenty Regional Council and Rotorua District Council, 50% of the funding for these interventions is sourced from central government.

Table 5: Lake Rotorua - Current Interventions and Costs

Current actions funded through the Funding Deed with the Crown				
Intervention	N removed (t/yr)	P removed (t/yr)	Total cost ($M)	Implemented or in progress
P-locking – Utuhina		2	3.6	✓
P-locking – Puarenga		2	4.05	✓
P-locking – Awahou		2	3.8	
Sediment capping		25	25	
Hamurana diversion	50-90	6	16	
Tikitere geothermal treatment	30		4.8	✓
Wetlands	Minor		1	✓
Land management change	170	6	9.5	✓
3 Community wastewater plants*	10.8	0.25	28.5	✓
Totals	**260 - 300**	**43.25**	**96.25**	
Expected Government contribution (assuming 50% of all listed actions) $M.			48.125	
*RDC had spent $3.5M upgrading the main wastewater treatment plant to remove more nutrients in 2006.				

Appendix C: Detailed assessment of different allocation approaches by staff and StAG

DRAFT Assessment of Possible Allocation Approaches

This assessment has been prepared by Bay of Plenty Regional Council staff. It is draft only and does not represent official views.

Purpose and scope

The focus of this paper is to:

1. Identify any allocation approaches that can be excluded from further consideration for the Rotorua Lake Catchment and document the reasons why.
2. Identify the possible allocation approaches that should be further considered for more in-depth analysis.

The paper outlines an assessment of a number of allocation approaches against a pre-defined set of criteria.

The tools (rules including trading and incentives) and technical information (Overseer, NZ Farm etc.) that may be required to compliment and implement the allocation approaches have not been considered in this paper.

Available allocation approaches

The following allocation approaches (including examples from national and international literature as well as regional experiences) have been considered by staff and the Stakeholder Advisory Group:

- Grandparenting
- Pastoral Averaging
- Sector averaging
- Land use capability
- Input based limit
- Output based limits

Definitions of these allocation approaches are provided in the appended assessments.

Assessment of approaches

Two sets of criteria were used to undertake an initial assessment of the various proposed allocation approaches. These criteria are outlined in detail in Attachment One.

The full assessment for each allocation approach is provided at Attachment Two.

Discounted Options

The assessment identified the following allocation approaches as not feasible as stand-alone allocation options[15] for the Lake Rotorua Catchment:

Grandparenting (including grandparenting with a proportionate reduction)

[15] As we continue our options analysis on possible allocation approaches, we may wish to revisit some of the approaches we have excluded earlier. That is ok. This assessment simply documents our reasoning to date.

- Land Use Capability
- Pastoral Averaging
- Input based
- Output based

However, aspects of these approaches have merits that could be explored further in any hybrid allocation approach(es) :

- Recognising existing land use
- Recognising existing investment
- Allocation that considers current nitrogen loss
- Allocation that encourages resource use efficiency

Aspects deemed to be missing or inadequate in the discussed allocation approaches include:

- Consideration of agreed good practice and land management practices that mitigate nitrogen loss
- Farm type
- Soil leakiness for N

Hybrid allocation approach(es)

The assessment supports a hybrid allocation approach that is tailored to the Lake Rotorua Catchment. Sector averaging is still considered a feasible option and could be the basis of a hybrid allocation approach.

The Stakeholder Advisory Group supported the option of a hybrid allocation approach at their meeting on 29 January 2013.

Benefits of a hybrid allocation approach

Different combinations of allocation mechanisms can be used to balance out burdens according to community values so that people's willingness to accept certain outcomes can be balanced.

Using hybrid allocation approaches also allows for variations to be made for environmental reasons. For instance, a smaller allowance may be given for areas within a catchment where the receiving environment is particularly sensitive.

Possible hybrid options

Some possible hybrid allocation methods to consider more detailed analysis include:

1. Sector averaging that takes into account:
    - Meeting the target
    - Good management practice.
    - Soil leakiness/natural leaching rates.
    - Farm type (taking into account farm size, imported supplements, N fertiliser usage, stocking rates and milk solids production).

2. Grandparenting each sectors' *proportion* of the total load (e.g. dairy makes up approximately 52% of the current 526t pastoral load and so would be allocated 52% of the target 256t pastoral load), and apply sector averaging within this proportional allocation.
3. Any others?

Attachment One: Criteria for assessing allocation approaches

Any allocation approach is going to have implications for:

- Land owner and municipal equity
- Economic viability of various sectors
- Future land use patterns
- Future land and urban development opportunities
- Social, cultural and economic development.

Therefore, the allocation approach(es) chosen and specific implementation methods need to be aligned to the characteristics of the lake Rotorua Catchment and its community.

Policy WL 5B in the Proposed Regional Policy Statement (RPS) provides principles for nutrient allocation for Lake Rotorua and other water bodies as follows:

Allocate among land use activities the capacity of Rotorua Te Arawa lakes and other water bodies in catchments at risk to assimilate nutrient discharges contaminants within the discharge limits established under in accordance with Policy WL 3B having regard to the following principles and considerations:

(a) Equity/Fairness, including intergenerational equity;

(b) Extent of the immediate impact;

(c) Public and private benefits and costs;

(d) Future vision for landscape;

(e) Iwi land ownership and its status including any Crown obligation;

(f) Cultural values;

(g) Resource use efficiency;

(h) Existing land use; and

(ha) Existing on farm capital investment; and

(i) Ease of transfer of the allocation.[16]

To ensure the allocation approach also achieves the stated nutrient target for the Rotorua lakes, an additional criterion has been included.

Staff have developed some explanatory text for what these criteria mean and how the criteria could be applied consistently (see Table 1).

The Stakeholder Advisory Group (StAG) have also considered draft nutrient allocation principles and guidelines that are additional to RPS allocation principles. These are:

1. There will be no major windfalls for any sector.
2. Preference will be given to the allocation approach that has the least overall economic impact.
3. Existing investment (including in infrastructure, land value, cash investment and in nutrient loss mitigation) will be recognised.
4. Practices that cause high nitrogen loss, relative to sector norms, will not be rewarded.

[16] It is important to note these criteria may change through resolution of Regional Policy Statement appeals.

Table 1. Suggested explanatory text for the principles and considerations identified in Policy WL 5B of the Proposed Regional Policy Statement (note these are staff suggestions not official views).

Equity/Fairness, including intergenerational equity
An allocation process seeking an equitable and fair solution that recognises • history of the issue • contribution of different land uses to the economy • investment An equitable and fair solution does not result in big windfall gains or losses and does not reward poor practice.
Extent of the immediate impact
This criterion focuses on negative impacts. For example: • immediate changes to land use and land management that may be required, and consideration of whether or not landowners have the capacity to make those changes in the short, medium or long term • economic impacts, including those on the lake's community (e.g. farming, tourism, recreation) Positive environmental, cultural and social impact will occur over time when the allocation approach is implemented.
Public and private benefits and costs
Public benefits relate primarily to the values the community derives from improved water quality. This is more relevant to implementation of allocation, rather than the allocation method itself. Public costs relate to compliance and transaction costs. These costs affect the ratepayer. Other public costs include social disruption and flow-on economic impacts. Private costs and benefits relate to landowners affected by allocation. Private benefits include certainty for land users, and opportunities for development, land use intensification and improved efficiencies. Private costs consist of cost of implementing changes imposed, initial reductions, mitigation costs, and limits on future land use flexibility.
Future vision for landscape
This considers whether the approach allows a transition towards a catchment where land is used efficiently and sustainably for an on-going prosperous community.
Iwi land ownership and its status including any Crown obligation
Implications of the approach on Māori owned land recognising the complexities of multiple owned land and how allocation may impact on the ability of Māori to plan for the strategic development of their land. Recognition of obligations under Treaty settlements.
Cultural values
The allocation approach allows landowners to use the concept of kaitiakitanga and stewardship. Other cultural values will be derived from improved water quality which relates to implementation of allocation.
Resource use efficiency
Considers whether the allocation approach: • Supports efficient use of land and resources • enables land use appropriate to the lands' natural capacity • supports sustainable land uses (sustainability tends to support resource efficiency)
Existing land use
Recognition of the way land is currently used, including current good management practices in place and mitigation measures already undertaken. Also considers the large variability within and between land uses, land use practices and nitrogen leaching rates.
Existing on farm capital investment
Recognition of investment in on-farm infrastructure (including nutrient management and mitigation measures).
Ease of transfer of the allocation
The ease of implementation of allocation and transition to that allocation approach including: • Degree of difficulty, time and cost involved in implementing the change required • Recognition of obstacles (including landowner buy-in)

Attachment Two: Detailed assessment of allocation approaches

Assumptions

- Generic assumptions have been made in the following assessment of allocation approaches:
- Our community wants a catchment where land is used efficiently and sustainably for an on-going prosperous community.
- Allocation of nitrogen loss and measures landowners take to meet their nitrogen loss entitlement won't further increase phosphorous losses.
- All allocation methods can be staged with transitional periods. An initial period would allow farmers time to adapt their systems, trade allowances or exit the catchment before compliance monitoring begins.
- For all allocation methods we are assuming a similar timeframe for implementation.
- Allocations can be tradable – this will create incentive for innovation and higher efficiency where the allocated nitrogen discharges are scarce.
- All activities that cannot reduce their current nitrogen loss (e.g. forestry, urban, rain on lake) will receive an allocation equal to their current loss. See table below.

N source	Area ha	load tN/y (ROTAN 2011)		
		current	reduction	target
pasture	21,175	526	270	256
geothermal	59	30	30	0
urban & sewage	3961	93	20	73
pines	8800	35	0	35
bush	12,382	40	0	40
rain on lake	8079	30	0	30
total	**54,456**	**755**	**320**	**435**

Specific assumptions are also made for each allocation method. They are provided in the following assessments.

Grandparenting

Allocation is based on existing discharges and every landowner would receive an allocation equal to their current discharge. This is status quo under existing Rule 11. A grandparenting approach was also used for the Lake Taupō Variation.

Assumptions:

- Good information on current discharges rates is available to inform individual property N discharge allocation.
- “Current” relates to operations and discharges resulting from implementation of Rule 11

Criteria	Comment
Meets policy intent	• No - Will not achieve required target as current discharge levels are greater than the target.
Equity/fairness	• This approach benefits those with highest discharges (giving them the most flexibility of what they do on the land) and penalises those with the lowest discharges. • It supports status quo and those with best practices will be worse off.
Immediate impact	• Enables businesses to continue without disturbing their current operations. Therefore no immediate upfront costs.
Public costs and benefits	• Community and iwi costs when nitrogen targets are not met. • Little long-term monitoring and compliance costs. • Potentially maintains or reduces impacts on current local agricultural economy.
Private costs and benefits	• Growth in intensity of agricultural production is curtailed • Low leaching enterprises cannot increase their leaching loss if they want to change land use activities • Least economic disruption to current landowners. • This allocation approach allows a continuation of activities so provides high level of certainty to current landowners.
Future vision for landscape	• Won’t achieve the vision as it doesn’t encourage a transition to more efficient resource use.
Iwi land ownership	• Likely to disadvantage undeveloped Māori owned land –as that land will receive a lower allocation and therefore restricts future development (see equity/fairness).
Cultural values	• At risk as water quality will not improve.
Resource use efficiency	• Land use limits are based on past land use rather than land use potential. • Under-developed land cannot develop like other land has in the past. • Potentially rewards current inefficiencies by allocating a higher number of discharge allowances to operations on lower class or high leaching land.
Existing land use and farm capital investment	• Recognises existing land use and sunk capital investment.
Ease of transfer	• Can be applied quickly if based on the information gathered through Rule 11 benchmarking. • No upfront costs to landowners. • Technically feasible.

Grandparenting allocation approach assessed against StAG criteria

No major windfalls for any sector	Existing investment will be recognised	Least overall economic impact	Practices with high nutrient discharge are not rewarded
✓	✓	✓	X
Key ✓ Meets criteria X Does not meet criteria			

Discussion

The policy intent will not be met with grandfathering, as it will not achieve a sustainable lake load of 435t/N/yr. The total “steady state” nitrogen load to Lake Rotorua from current land use is estimated to be 755tN/yr. Therefore, grandparenting cannot be considered as a stand-alone allocation approach.

Staff also considered grandparenting with a proportionate reduction to meet the N target for the lake. To reduce the current pastoral discharge from 526 tN/yr to the required 256 tN/yr equates to an approximate reduction of 50%. This means that if a current nitrogen discharge from a dairy farm was 56 kg/ha/yr and a dry stock farm was 16 kg/ha/yr then their discharges would need to drop to 28 kg/ha/yr and 8 kg/ha/yr respectively. This could be technically and/or financially unfeasible for some land uses.

This approach would penalise those with little room to move or improve and could force them out of their current land use to a lower leaching land use. This could create significant economic impacts.

The above assessment does identify aspects of grandparenting that have merit for inclusion in a hybrid approach. These include:

- Recognise existing land use.
- Recognise existing investment.
- Allocation that considers current nitrogen loss rates.

It is recommended that these aspects be considered as part of any hybrid model(s).

Land Use Capability

The land use capability class approach assesses the physical quality of the land, soil and environment and its productive capability and corresponding loss of nitrogen. Basing an allocation approach on this system means that higher nutrient limits would be allocated to more versatile classes of land, thus improving overall efficiency of land use in the long run.

Assumption:

- More versatile soils are more productive; higher leaching activities should occur on the most productive lands.
- We have the data necessary to determine the most suitable characteristics on which to base the allocation (LUC, N leakiness, etc.).

Criteria	Comment
Meets policy intent	• Yes, providing the N target is used as the basis of the allocation.
Equity/fairness	• Degree of equity as it is partially independent of current land uses. It treats land in the same manner regardless of current use. • Does not recognise existing land uses or the variations in management techniques that are currently in place to deal with environmental variability.
Immediate impact	• There would be a significant and immediate impact as a majority of dairy and drystock farms are on class 4 and 6 land in the Rotorua catchment. Therefore, allocating the bulk of nitrogen to class 1-3 land would disrupt many agricultural landowners at the catchment scale. • Only 15% of the catchment is class 2/3 land. Thus, there is limited additional land that could be suitable for dairy even if relocation of dairying was a desirable objective.
Public costs and benefits	• Significant private costs are likely to have some broader downstream and flow-on costs to the wider community. • Could completely change the rural and urban landscape – which may be either a benefit or a cost. • Encourages sustainable and efficient land use in the long-term reducing future mitigation costs and achieving a clean lake
Private costs and benefits	• Potential benefits for landowners on land considered more versatile (ie have higher leaching allocation) to further reduce their N leaching and sell their excess N loss reductions to others • Cost to intensive farmers on less productive land. Only 15% of the catchment is Class 2/3 land. 81% of existing dairy and 73% of existing dry stock is on class 4-6 land.
Future vision for landscape	• Allows flexibility on what can be produced on the land. • Encourages versatile land to be used more intensely for production. • By encouraging land uses to move to its most suitable location, aligns with assumption that the community wants a catchment where land is used efficiently and sustainably.
Iwi land ownership	• The accompanying map shows Māori owned land with lower productive capability (classes 6-8). See costs above.
Cultural values	• Cultural benefits from a clean lake. • Supports concept of kaitiakitanga.
Resource use efficiency	• Does allow flexibility on what can be produced on the land. • LUC Classes do not determine actual or predicted amounts of nutrient leaching from soils – its intent is to encourage intensive farming towards higher quality soils. • Efficient approach because it encourages production in the most appropriate places. Flow on effect is improved economics. • Sustainable land uses do not necessarily correspond to the land use classification class as LUC does not capture all considerations. For example, class 2 land could be leaky and be next to the lake with a higher probability of that N reaching the lake.

Existing land use and farm capital investment	• Results in a large shift of existing land uses. • Does not acknowledge significant historical investment in infrastructure including nutrient mitigation expenditure.
Ease of transfer	• Complex - Many farms in Rotorua catchment have a number of different LUC classes and it will be difficult to determine how nutrients will be allocated at the property scale. • Resource intensive - Issues associated with the accuracy of LUC mapping. • Not supported by affected landowners (StAG) so risk of poor cooperation from many landowners.

Land use capability allocation approach assessed against StAG criteria

No major windfalls for any sector	Existing investment will be recognised	Least overall economic impact	Practices with high nutrient discharge are not rewarded
-	X	X	X
Key ✓ Meets criteria X Does not meet criteria			

Discussion

Allocation based on LUC or natural capital alone does not specifically address inputs or leaching rates, but it can be designed in such a way that the target can be achieved.

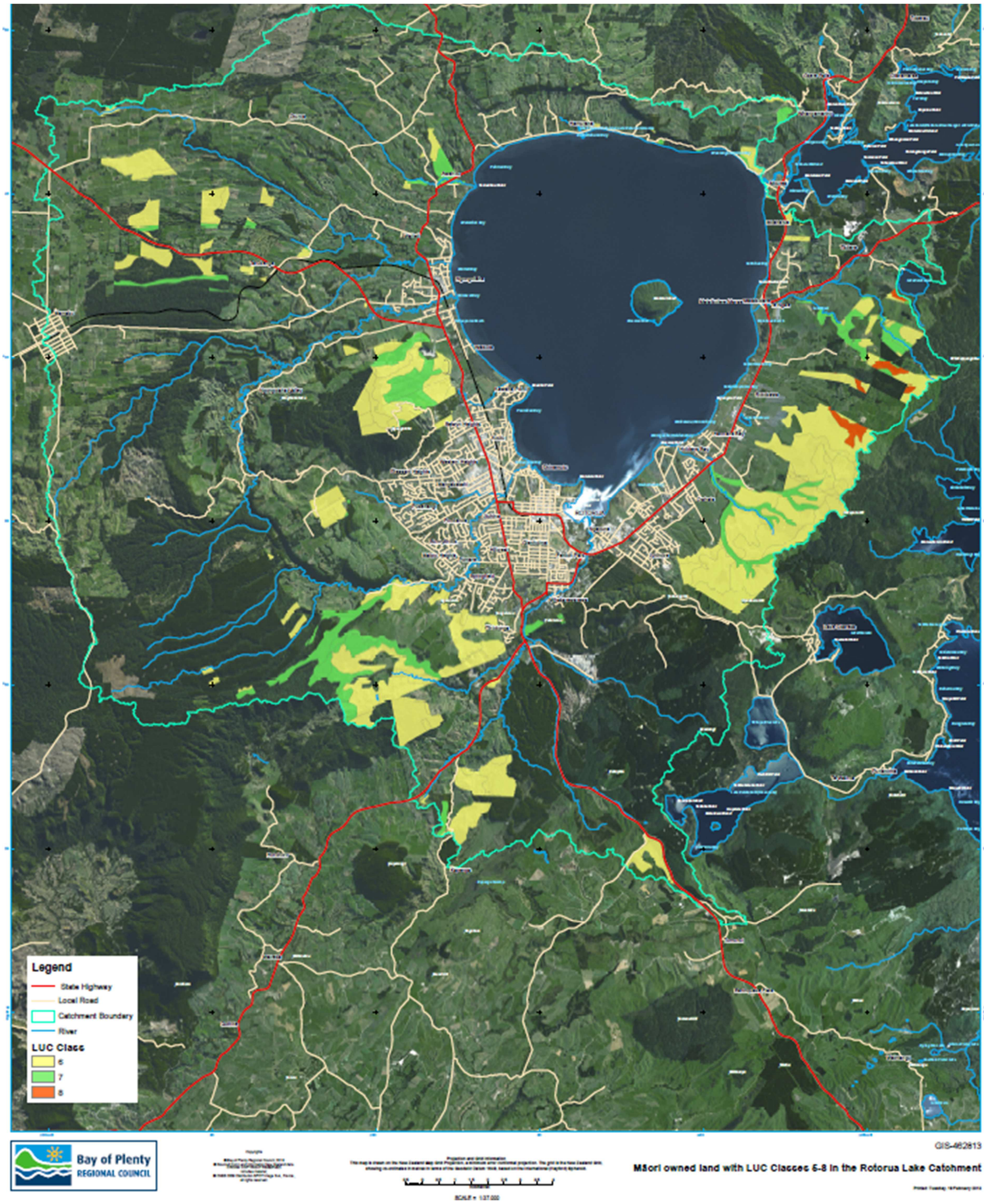
While this approach recognises the capacity of the land, it is difficult to see it as appropriate in the Rotorua context because:

a) Poor correlation between LUC and current land use in the Lake Rotorua catchment.

b) Not enough scope for existing farm operations to change where they operate to align with land use productivity (see attached slide).

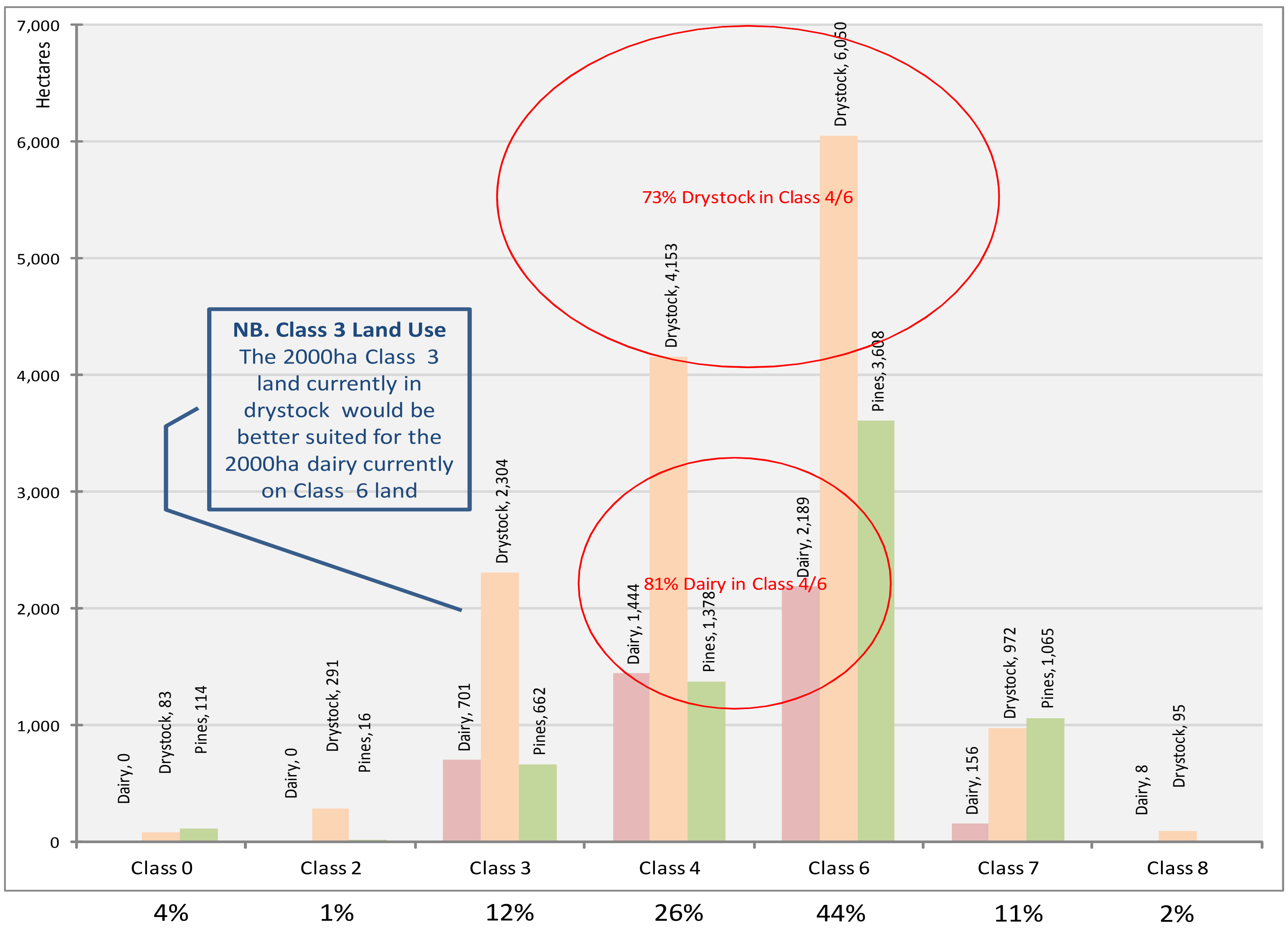
c) Doesn't recognise all the existing mitigation landowners have already adopted to compensate for soil characteristics.

However, the Regional Policy Statement recognises land use capability as a tool to achieve integrated management. LUC could form part of a high level policy response to achieve the vision for the catchment over the next 50 years rather than as a basis for allocation. We have assumed our community wants a catchment where land is used efficiently and sustainably for a prosperous community. Land use planning could be guided by LUC as opportunities for change arise in the future.


Legend
State Highway
Local Road
Catchment Boundary
River
LUC Class
6
7
8
Bay of Plenty
REGIONAL COUNCIL
GIS-462813
Māori owned land with LUC Classes 6-8 in the Rotorua Lake Catchment

Land Classification vs. Existing Use

Is allocation by Land Capability relevant in this catchment?



Pastoral Averaging

This is where the sustainable pastoral load (256 t) is divided by the pastoral catchment (21,175 hectares) to give an average N leaching of12kg/ha. Every pastoral landowner in the catchment would receive 12 kg/ha.

Also referred to as equal allocation.

Assumption:

- Averaging only applies to pastoral farming.

Criteria	Comment
Meets policy intent	• Yes. Modelling has shown that to achieve 435t, pastoral farming needs to reduce to 256T. Allocation would be based on meeting this target.
Equity/fairness	• An equal allocation for everyone. • Large wealth transfer – for example windfall gains for undeveloped land or landowners operating below 12 kg/ha as they will be able to sell their excess allowance. • Losses to land uses such as dairy (5050 ha) as they will be required to purchase allowances to continue to operate. • Higher leaching land uses are heavily penalised through the requirement to purchase large number of nutrient discharge entitlements.
Immediate impact	• Large upfront costs to some farmers - they would have to reduce nitrogen to meet rule or purchase discharge allowances from foresters or owners of undeveloped land. • May not be technically feasible to dairy farm at 12 kg/ha so dairy farmers would be required to obtain additional allowances immediately.
Public costs and benefits	• May force certain farm types out of the catchment – loss of diversity in land use. • Likely downstream or flow-on social and economic effects that could impact the community. • The benefits from a clean lake through achieving water quality aspirations over time.
Private costs and benefits	• A cost is the ability to continue dairy farming may not be technically possible without significant new investment. • A benefit is that it provides an incentive to innovate and diversify land use and management.
Future vision for landscape	• Will encourage resource efficiency and prosperity in the long term, so will provide a relatively easy transition to achieving the vision.
Iwi land ownership	• Opportunities for owners of undeveloped “Māori land that are assigned a higher discharge allowance than current discharge levels.
Cultural values	• Meets target so cultural benefits to lake.
Resource use efficiency	• The trading of leaching entitlements can direct those permits to their most efficient use. • Does not encourage marginal land to be retired.
Existing land and farm capital	• Does not acknowledge historical investment in infrastructure

investment	including nutrient mitigation expenditure.
Ease of transfer	• Risk of poor co-operation from land owners. • Risk that holders of nitrogen allocation surplus refuse to sell.

Pastoral averaging allocation approach compared against StAG criteria

No major windfalls for any sector	Existing investment will be recognised	Least overall economic impact	Practices with high nutrient discharge are not rewarded
X	X	X	✓
Key ✓ Meets criteria X Does not meet criteria			

Discussion

Pastoral averaging will heavily penalise higher leaching land uses and higher leaching environments. This allocation approach does not recognise existing land use (including investment), management practices that may reduce leaching, soil type (leakiness) or areas with higher rainfall.

The Stakeholder Advisory Group does not support pastoral averaging as an allocation approach for the Lake Rotorua Catchment.

The above assessment does identify the following aspect of pastoral averaging as having merit for inclusion in a hybrid approach:

- Resource use efficiency.

It is recommended this aspect be considered as part of any hybrid model(s).

Sector Averaging

This method allocates an averaged level of nutrient discharge rights across specific types of land use e.g. dairy, sheep and beef, deer and forestry.

Assumption:

- Good information on current discharges rates is available to inform individual property allocations.

Criteria	Comments
Meets policy intent	• Yes, provided the total allocation achieves a pastoral N leaching loss of 246T meaning the 435T target is met.
Equity/fairness	• All landowners with similar land uses are expected to achieve the same leaching levels. • Landowners who have developed their pastoral land are more likely to be able to continue their current land use. However, those on undeveloped land (eg. forestry) will be limited in their options.
Immediate impact	• Change required for landowners who have higher discharge rates than the sectoral average (which would achieve the target).
Public costs and benefits	• Benefits from a clean lake through achieving water quality aspirations over time. • On-going Regional Council compliance and monitoring costs.
Private costs and benefits	• Benefits from providing certainty to landowners. • Benefits to those landowners who have used good nutrient management practices as they will more easily meet their nitrogen discharge allowance and have more flexibility for land use options. • Mitigation costs for those landowners with currently high levels of N leaching
Future vision for landscape	• Could force land use change for landowners with high leaching levels.
Iwi land ownership	• See costs.
Cultural values	• This approach will improve water quality and therefore recognise cultural values.
Resource use efficiency	• Encourages good practice to reduce N leaching. • Can encourage marginal land to be retired. • A pure sector averaging approach does not account for variability between soil leaching rates, rainfall etc.
Existing land and farm capital investment	• Recognises existing land use and sunk investment.
Ease of transfer	• Already have information on current discharges (2001-2004) to guide level of change required. • May be unfeasible for some farms to be viable.

Sectoral averaging allocation approach compared against StAG criteria

No major windfalls for any sector	Existing investment will be recognised	Least overall economic impact	Practices with high nutrient discharge are not rewarded
✓	✓	-	✓
Key ✓ Meets criteria X Does not meet criteria			

Discussion

Unlike the pastoral averaging approach, sector averaging recognises current land use, investment and management techniques that reduce leaching rates.

However, every farm is different and it is impractical to say that every hectare of land of the same land use will discharge the same amount of nitrogen (e.g. dairy with high (>2000mm) and low rainfall). The Stakeholder Advisory Group supported sector averaging as an allocation approach.

Some useful concepts to incorporate into a hybrid model include:

- Recognise existing land use.
- Recognise existing investment.
- Allocationconsiders current rates of nitrogen leaching.
- Supports good land use practice.

Input Based Allocation

Input based allocation focuses on controlling the inputs to land use operations by directly managing the amount of nutrients being applied on land. For example, controlling fertiliser and feed application rates.

Assumptions:

- Managing what goes onto a farm can be used to control what is discharged.
- Good data is available that identifies the relationship between inputs and nitrogen loss.

Criteria	Comments
Meets policy intent	• Possible, but it is difficult to link the input control with the nitrogen leaches with any precision. Also, given the scale of reduction required, it is unlikely that traditional input rules will be able to achieve the limit.
Equity/fairness	• Doesn't acknowledge that some landowners have already heavily invested in mitigation techniques to minimise losses, and if these don't fit with the input controlled approach they will be penalised. • All individuals within each sector are treated equally.
Immediate impact	• May require immediate change to existing operations. • Unlikely to result in significant land use change across the catchment.
Public costs and benefits	• On-going Regional Council compliance and monitoring costs. • Further Regional Council (and other) investment to derive the correlation between land inputs and discharges e.g. take into account variances in soil type, climate difference, lag etc. • On-going research and assessment costs as farm inputs change over time.
Private costs and benefits	• Landowners currently operating in accordance with the regime will not have to change (benefit). • Landowners not operating in accordance with the regime will be impacted significantly (cost).
Future vision for landscape	• Doesn't address future vision as it doesn't really change the status quo catchment landscape, and doesn't encourage innovation or diversity.
Iwi land ownership	• May provide new opportunities in undeveloped land, provided it complies with input requirements.
Cultural values	• May not meet limit so unlikely to reflect cultural values.
Resource use efficiency	• Does not require marginal land to be retired or high quality land be intensified. • Limits on inputs could encourage resource efficiency. • Opportunity for land-users, industry sectors and fertiliser companies to develop best practice.
Existing land and farm capital investment	• Does not explicitly acknowledge significant historical investment in infrastructure including nutrient mitigation expenditure. Also doesn't reflect diverse 'non-input' approaches to nutrient management that may be equally valuable.

Ease of transfer	• Hard to implement, may require complex and expensive monitoring and enforcement systems. • Relies on high degree of cooperation from land users. • Feasibility of future continuation of all land users unknown.

Input allocation approach compared against StAG criteria:

No major windfalls for any sector	Existing investment will be recognised	Least overall economic impact	Practices with high nutrient discharge are not rewarded
✓	X	-	✓
Key ✓ Meets criteria X Does not meet criteria			

Discussion

Input and output based allocation is used as surrogate measures for actual (or estimated) N leaching losses. This approach was suggested in response to the potentially high cost and feasibility of measuring or estimating N leaching losses per property in real time.

Of most concern with this approach are the challenges involved in determining the relationship between inputs and nitrogen leaching loss for each climatic, soil and management option. This allocation approach also does not recognise variations in management techniques that may already be in place to mitigate N losses or in response to other environmental or management concerns a landowner may have..

The above assessment identified the following aspects as having merit for inclusion in any hybrid approach(es):

- Resource use efficiency.

It is recommended this aspect be considered as part of any hybrid model(s).

Output Based Allocation

Under an output based approach allocation is based on the greatest units of output leaving a property (e.g. milk solids, timber, kg of meat). An example would be allocating to a landowner based on how many kg of milk solids or revenue produced per 1 kg of nitrogen leached.

Assumptions:

- There is a strong relationship between product output and N leaching.
- Good data is available that identifies the relationship between outputs and nitrogen leaching.

Criteria	Comments
Meets policy intent	• Possible, but unlikely unless the initial calculation of output/N leached is scaled to meet the target. Although we know the N target we need to achieve, we have limited understanding of how this is linked to farm outputs
Equity/fairness	• Doesn't acknowledge that some landowners have already heavily invested in mitigation techniques to minimise losses, as all landowners face the same N leaching allocation per unit of output.
Immediate impact	• May require change to existing operations. • Detailed information required to determine relationship between output and discharge levels.
Public costs and benefits	• On-going Regional Council compliance and monitoring costs. • Further regional council (and other) investment to derive the correlation between output and discharge levels
Private costs and benefits	• Benefits to people who use nutrient most efficiently . •
Future vision for landscape	• Potential public benefit associated with allocation going to those who can generate the most return. Flow on economic impact.
Iwi land ownership	• All landowners are treated the same.
Cultural values	• May favour economic values over other values.
Resource use efficiency	• Supports not giving allocation 'units' to inefficient use.
Existing land and farm capital investment	• Does not acknowledge historical investment in infrastructure including nutrient mitigation expenditure.
Ease of transfer	• Hard to implement, requires complex monitoring and enforcement systems. • Relies on high degree of cooperation from land users. • Feasibility for any landowners unknown.

Output based allocation approach compared against StAG criteria:

No major windfalls for any sector	Existing investment will be recognised	Least overall economic impact	Practices with high nutrient discharge are not rewarded
-	X	-	X

Key
✓ Meets criteria
X Does not meet criteria

Discussion

Input and output based allocation is used as surrogate measures for actual (or estimated) N leaching losses. This approach was suggested in response to the potentially high cost and feasibility of measuring or estimating N leaching losses per property in real time.

This approach could be complex to implement because of the challenges to:

- Establish the relationship between product output and N leaching
- Determine the factors that (could) disrupt that relationship in a way that cannot readily be seen/accounted for
- Production outputs are likely to be highly variable due to factors outside landowner control, eg. market, economics, climate, disease, pests.

For these reasons, staff do not consider output based production as a feasible option for the Lake Rotorua Catchment.

Appendix D: Confirmation of sector averages and allowances

Staff recommend that the ROTAN estimated discharge figures be used to define sector averages. The Rule 11 benchmark figures are more precise as they are the result of a process to measure nitrogen loss through OVERSEER®. However, it is the ROTAN estimates that have been used to derive the total nitrogen inputs in the catchment and support the lake modelling that defined sustainable loads for the Lake Rotorua catchment.

There are many land uses in the catchment, but not all are relevant in the context of allocating nitrogen to individual "sectors". The benchmarking process has identified a variety of different "block types[17]" in the catchment, each with very different nitrogen loss profiles (see Table 6 below). In contrast, ROTAN has used a far more simplified approach, aggregating many associated land uses together (see Table 7 below).

Table 6: Block types, area and average nitrogen loss for benchmarked properties in the Rotorua catchment (using the Rule 11 surface water area)

Block Type	Area from benchmarking	Average N/kg/ha/yr
Crop	63	40
Cut and Carry	172	13
Fodder (Dairy Support)	96	97
Fodder (Dairy)	250	109
Fodder (Dry Stock)	168	102
Fruit Crop	2	11
Pastoral (Dairy Support)	2,100	23
Pastoral (Dairy)	3,712	49
Pastoral (Dry Stock)	13,172	12
Pastoral (Effluent)	508	52
Riparian	409	3
Trees (Bush and Scrub)	8,520	3
Trees (Forestry)	7,116	3

[17] "Block type" is simply the term used in the benchmarking process to define the predominant land uses within individual properties

Table 7: Land use types, area and average nitrogen loss modelled in ROTAN for the Rotorua catchment (using the Rotorua catchment groundwater area[18])

Source of nitrogen	Area estimated (ha)	Average N/kg/ha/yr
Dairy	5050	54
Drystock	15072	16
Forest	21182	4
Lifestyle	1053	16

There will be some large variations in nitrogen discharges amongst different block types that have been benchmarked. However, allocating allowances across a large number of different block types is challenging. This is because individual properties are made up of many block types – for example, a dairy farm may have trees, fodder, dairy support, effluent, as well as effective area. Providing that farm with five separate allocations to cover each block type will be administratively complex, and most likely confusing to the landowner.

Many block types are also minor in terms of catchment area. For example, all fodder blocks have relatively high discharges, but make up less that 1% of the catchment. It does not make sense to have specific provisions for allocating these land uses.

Dairy support

Staff have included dairy support in the drystock sector. There is an argument to include dairy support as a sector independent of just dairy or drystock. Dairy support is essentially the wintering off of cows, and many drystock farmers lease parts of their land (or arrange access by contract) as a way to increase farm profits. The Farmers Solutions Project indicates this is becoming increasingly attractive to drystock farmers as sheep and beef prices are so low.

Dairy support has a higher nitrogen discharge associated with it that the average drystock discharge. There is concern that rolling it up into drystock will mean that it will not be explicitly provided for and may result in farmers not having high enough allowances to continue to operate. However, it is not recommended that dairy support be included as a separate sector because:

- It is inherently hard to identify where dairy support will be in the catchment as it is not a permanent land use
- There is likely to be a lot of dairy support on properties <40ha. These properties have not been benchmarked so it would be difficult to determine who would be entitled to a dairy support allocation (particularly as the land use reference years are 2001-04)

[18] Note that the groundwater area is larger than the Rule 11 surface water area. Estimated block type areas will not match up to areas defined in ROTAN. Work is underway on expanding the Rule 11 information database to estimate land use and nitrogen discharges for those properties outside the Rule 11 area.

Staff acknowledge that farm changes may be required to continue to provide dairy support (such as part land use change to forestry to lower property-scale discharges). There may also need to be a change in the way leasing or contracting occurs, with the herd owner (dairy farmer) providing a nitrogen allowance to the land owner (drystock farmer) to cover the higher discharge rates over the wintering off period.

Lifestyle

Staff have also grouped the ROTAN "lifestyle" land use in with drystock. The definition of "lifestyle" is not clear and given the average discharge is the same as drystock, and the total area is relatively small, grouping with drystock is unlikely to cause problems.

Appendix E: Analysis of preference determinants for the two allocation options provided

Preference Determinants	Trends	Farm type	Grandparenting	Sector Averaging
Level of Nitrogen Loss	There is large variation in baseline nitrogen losses. It is that variation that determines the relative impact of the allocation options	High nitrogen loss	✓	
		Low nitrogen loss		✓
Cost Sharing	Mitigation costs to each farmer are equal across both scenarios. It is the manner in which allowances are allocated among dairy farmers that have an impact on cost sharing.			
Productivity	More productive farmers tend to have higher than average levels of nitrogen losses.	More intensive farmers	✓	
		Less intensive farmers	-	-
Production Efficiency	More efficient farmers tend to have lower nitrogen losses per hectare.	More efficient farmers		✓
		Less efficient farmers	✓	
Rainfall	Farms receiving more rain tend to have higher baseline nitrogen losses.	High rainfall	✓	
		Low rainfall		✓

Key
✓ Preferred approach
- Weak or no relationship