This paper presents a first draft of the allocation policy advice that Bay of Plenty Regional Council staff are currently preparing for Council's decision on 6 August.

This draft is incomplete. However, staff are seeking StAG's advice and recommendations on key aspects of the policy.

**In particular, staff would like StAG's views on:**

**a) the pros and cons of allocation using a sector average approach**

**b) the pros and cons of allocation using a grandparenting approach**

**c) any preferences between sector averaging and grandparenting**

**d) ways to modify the preferred approach to be more suitable (ie. a hybrid)**

**e) whether or not a trading scheme is supported**

Staff have highlighted sections in the report that relate specifically to the five points above.



StAG consideration and advice to date has been:

- 3 Dec: confirmed requirement to reduce pastoral nitrogen loss from 526t/yr to 256t/yr
- 29 Jan: discussed different approaches to allocating the 256tN/yr
- 14 Feb: drafted allocation principles
- 19 Mar: assessed allocation approaches; broad agreement to analyse sector-average allocation and compare against grandparenting
- 16 Apr: agreed to include Rule 11 data in allocation
- 13 May: considered Mōtū's draft results from the analysis of allocation options

# Policy decision paper: allocating Lake Rotorua's sustainable nitrogen limit amongst land use activities

## 1.0 Purpose

The purpose of this paper is to determine Council's preferred approach for allocating Lake Rotorua's sustainable nitrogen limit amongst land use activities in the catchment. The decisions required in this paper are:

1. Confirm catchment-wide distribution of the sustainable load
2. Decide on preferred allocation approach to land use activities
3. Agree to progress the development of a nitrogen trading scheme
4. Note other issues (e.g. gorse and multiple owned Māori land)
5. Confirm next steps

## 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[1]. 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.

Recent 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 [The project report is provided for information as a supporting document].

Staff note that there are some inherent assumptions and uncertainties in the science and information used to determine the TLI, sustainable load, as well as current nitrogen inputs to the lake. These assumptions and uncertainties are outlined in Appendix 1.

[1] When the Rotorua city sewage discharge was moved to land disposal, water quality expectations for the lake were stated in documents associated with the consent. That target was for Lake Rotorua's water quality to be similar to its 1960s' water quality. The target trophic level index was established in the Proposed Regional Water and Land Plan which was publicly notified in 2001.

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

| 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 it as a target in the Regional Water and Land Plan (2001)
- Rule 11 in the Regional Water and Land Plan is implemented to cap nitrogen losses 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 (2012)
- 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. The direction is:

- **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

[2] Nitrogen figures are based on the most up to date ROTAN modelling work done in April 2011
[3] Including sheep, beef, horticulture and cropping
[4] Including urban, urban open space, sewage and sewage treatment

- **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 load, nutrients from the catchment will take a long time to travel through groundwater to the lake. Changes in the way land is used 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 load. However, it may take up to 100 years for the lake load to fully adjust and reach the sustainable load 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 in order to meet Lake Rotorua's water quality target. This includes advice on implementation options and District and Regional statutory plans.

The Group includes 12-15 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.

- StAG to identify the extent to which they are acknowledged and the advice they wish to provide.

## 2.3 Impacts of achieving the Proposed RPS sustainable load

An assessment of the impacts associated with achieving Lake Rotorua's sustainable nitrogen load 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.

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

### Costs associated with achieving the sustainable load

Achieving the sustainable load will have significant social and economic impacts, both locally as well as across the region. The scale of nitrogen reduction required, particularly for 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 the lake.

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 load 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.

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[5] 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.
- 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 load 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 load 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 this allocation work. Under this scheme $45.5 million dollars has been proposed for the purpose of encouraging land use change in the catchment to reduce nitrogen loss and help achieve the sustainable load. The development of the incentive scheme and the criteria setting out 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 should 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.

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

### Benefits of achieving the sustainable load

No attempt has yet been made to quantify the benefits associated with a clean Lake Rotorua.

Importantly, however, achieving the sustainable load 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 'intangible' non-market benefits resulting from improved water quality in the lake. This includes increased recreational opportunities, and the enhanced provision of ecosystem services.

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 tourist 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.
- 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. The figures are provided just to acknowledge a correlation between a clean lake and the economy.

## 3.0 Allocation of nitrogen discharges

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

Staff consider that there are three critical steps required in the decision to allocated the sustainable load:

1. Determining how the sustainable load can be broadly distributed across the catchment given the current sources of nitrogen that have been identified through lakes modelling

2. Specifically allocating nitrogen discharge allowances to land use activities within the catchment, in such a way that will achieve the sustainable load
3. Confirming whether or not a trading scheme will be used to support the allocation of nitrogen in the catchment.

## 3.1 Catchment-wide distribution of the sustainable load

This step is about determining how the 435t sustainable load can be broadly distributed across the catchment.

Table 1 identifies the current sources of nitrogen loss to the lake from the catchment. In order to distribute the sustainable load across these sources, we need to understand what sources are unmanageable, what have already been reduced, and what are actually manageable (ie. can be reduced).

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.

Interventions to reduce nitrogen from some sources have already been made, or are being planned for (costs and progress are outlined in Appendix 2). These are:

- *Geothermal sources*: in-lake interventions are underway to completely remove nitrogen that enters the lake from geothermal sources by treating the Tikitere geothermal springs. This will achieve a 30tN/yr reduction.
- *Urban sources:* nitrogen losses from urban sources have already been reduced significantly, at cost to ratepayers in the community. A further reduction of 20 tN/y from urban sources is planned from sewage reticulation/upgrades and stormwater treatment[6].

Given the unmanageable loads identified, as well as interventions already planned, further reductions to achieve the sustainable load will need to come from pastoral activities.

Therefore the proposed catchment-wide distribution of the sustainable load is provided at Table 2.

Staff note that because losses from forest and bush are 'unmanageable', the forest allocation is equal to the current loss attributed to this land use. This could be perceived as unfair as it takes away the ability for the commercial forestry sector (as well as landowners with forest on their land) the ability to change or intensify their land use in the future. However, opportunities to change from forestry or bush to a higher intensity land use were already affected following implementation of Rule 11 in the Regional Water and Land Plan.[7]

[6] Staff note that the Rotorua District Council are currently seeking a variation to their discharge consent to increase the Rotorua Wastewater Treatment Plant from 30t N/yr to 51tN/yr. This is an interim measure while the Council look at options to improve the performance of the treatment plant.

[7] If a trading scheme is implemented, owners of forest land could purchase nitrogen allowances and intensify their land use if the benefits in intensifying outweigh the costs of allowances and any land conversion required.

**Table 2: Catchment-wide distribution of the sustainable load**

| Source of nitrogen | Current N input (t/yr) | Future proposed N input (t/yr) |
|---|---|---|
| Pastoral (dairy, drystock, lifestyle) | 526 | 256 |
| Forest | 75.4 | 75.4 |
| Urban and sewage | 93.4 | 73.4 |
| Geothermal | 30.3 | 0 |
| Rain | 30 | 30 |
| TOTAL | **755** | **435** |

***Recommendation 1:*** ***Confirm the catchment-wide distribution of the sustainable load as identified in Table 2.***

## 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 load. This means that for pastoral land use, the amount of nitrogen discharge allowances that can be allocated will need to be more than halved, 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, in order to achieve the reduction 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 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 3.

While it is clear that there are pros and cons associated with all allocation approaches, it is recommended that 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 mechanisms can be used to balance out burdens. 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.

# 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 the 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 (the reduction required for pastoral land use across the Rotorua catchment) are displayed. The example shows that for farms with relatively high nitrogen losses, the reduction required to achieve the (reduced) average 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.

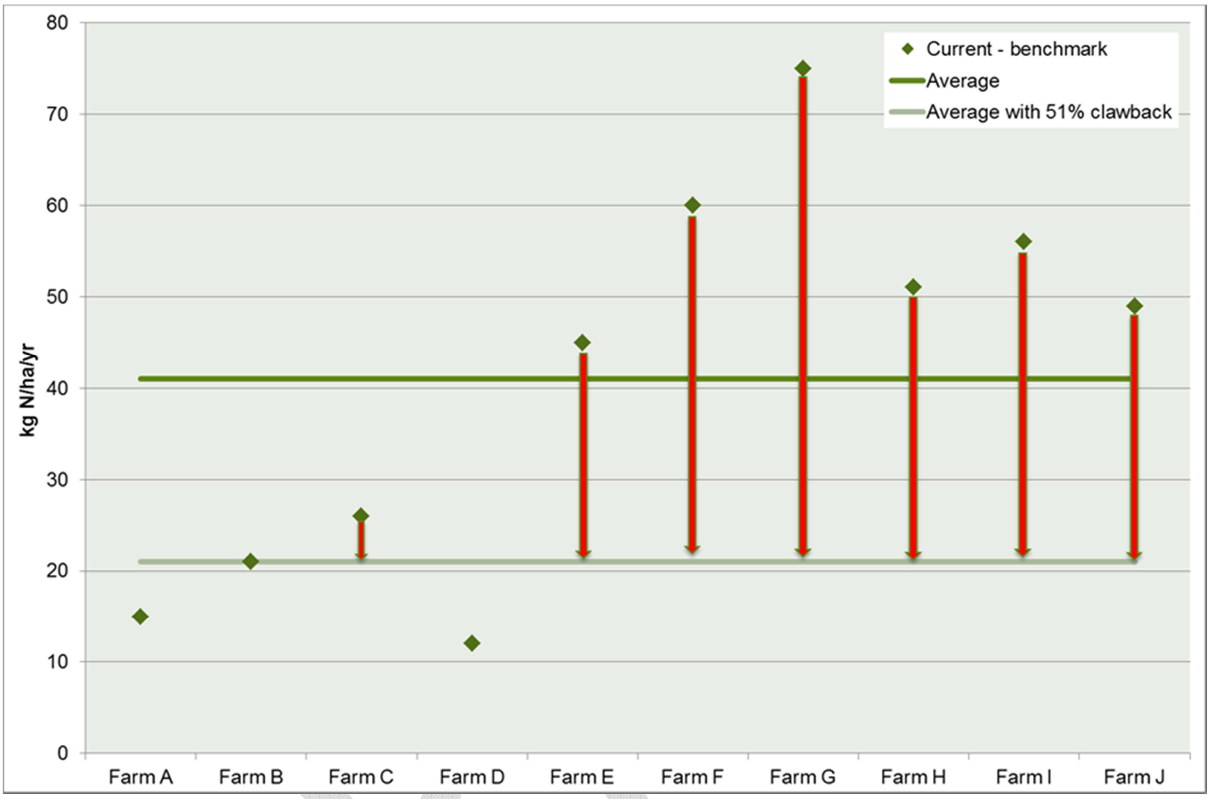


**Figure 1: Reduction required from ten hypothetical farms when allocating using a sector average approach, with a 51% reduction applied to the sector average.**

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 nitrogen loss.

## Defining sectors and associated averages

In order 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 4, 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 support the lake modelling that has been key in defining sustainable loads.

**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 |
| Forest | 4 | 4 |

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 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 to those proposed by staff.

**Table 3: Potential variations in the way allowances could be allocated to sectors. The proposed allowances are highlighted in pink.**

| 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 |

## Implications for the Lake Rotorua catchment

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 (see Figure 2). In addition, no dairy support (considered drystock for the purposes of this allocation method) is currently benchmarked as low as 8kg N/ha/yr.

The required rate of reduction for highest nitrogen leaching farms to achieve the sector allowances will be significant. For the dairy sector, reductions from benchmarked losses of about 45% will be required on average but may be as high as 65%. For the drystock sector, reductions of about 50% will be required on average but may be as high as 80% (see Figure 2).

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 36 kg/ha/yr, or 29 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 far less room to move and it is likely that a sector allowance of 8 kgN/ha/yr will result in large scale land use change across the catchment.

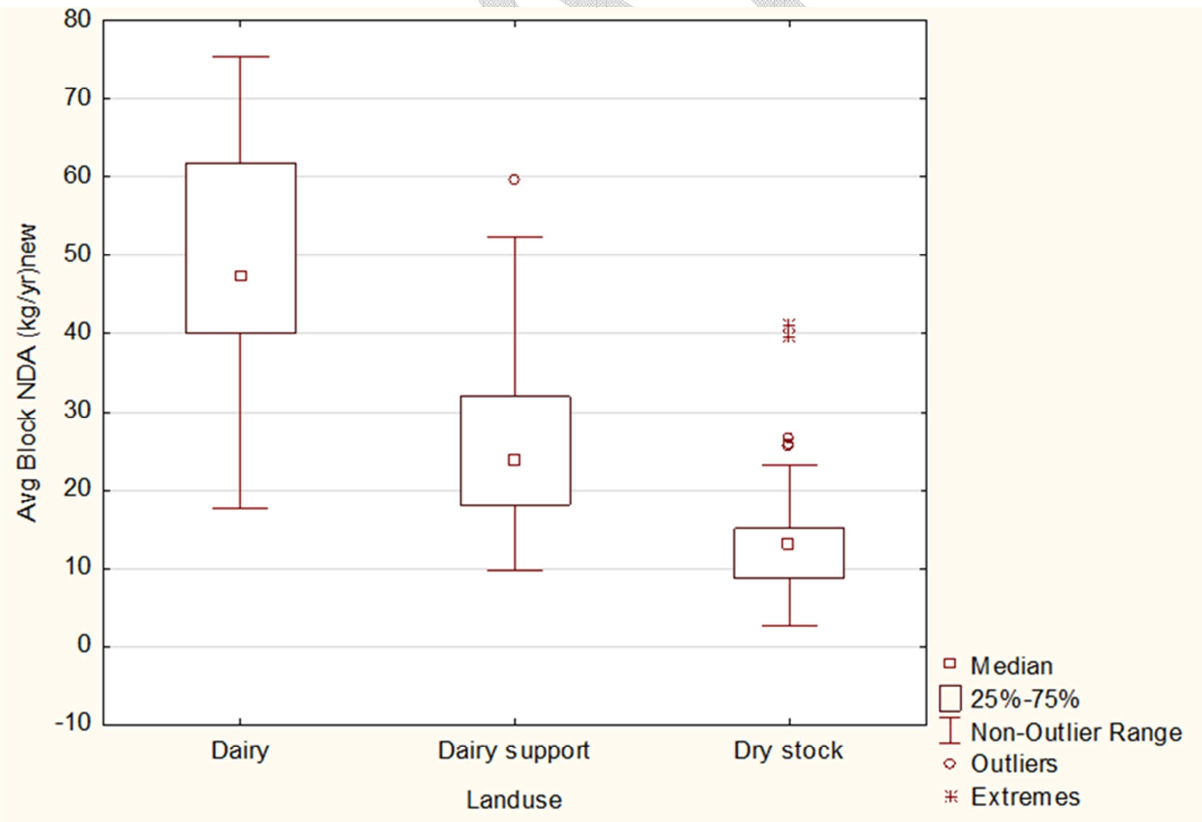


**Figure 2: Range of nitrogen loss (kg/ha/yr) for dairy (n=26), dairy support (n=41) and drystock (n=100) in the Lake Rotorua catchment (based on Rule 11 benchmarking)**

### Potential advantages of the sector average approach

- Some low leaching land uses may not be required to substantively change
- Where nitrogen loss of an individual property is less than the allowance allocated, landowners could intensify or sell surplus
- Tends to benefit less developed land
- Could reward past mitigation and more sustainable farming practices – those with good management practice might be operating close to the nitrogen discharge allowance and have more flexibility for land use options. It is noted, however, that for those that have already implemented best management practice it will be harder to lower nitrogen losses any further.

### 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
- Large scale of reduction (and therefore high costs) for high nitrogen loss properties
- Administratively complex as most properties have multiple land uses. It is conceivable that some properties will require a dairy, drystock and forest allowance.

**Question for STAG: what do you think the pros and cons are of using a sector average allocation approach?**

## 4.2 Option Two: grandparenting

Grandparenting is allocating nitrogen allowances based on current discharges, and includes any proportional reduction that may be required to achieve targets.

For the purposes of this report, grandparenting is based on existing discharges as determined by the Rule 11 2001-04 benchmarking. In order 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.

Figure 3 uses the example of the ten hypothetical farms from Figure 1 to show the reduction required from their current nitrogen loss under a grandparented 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.

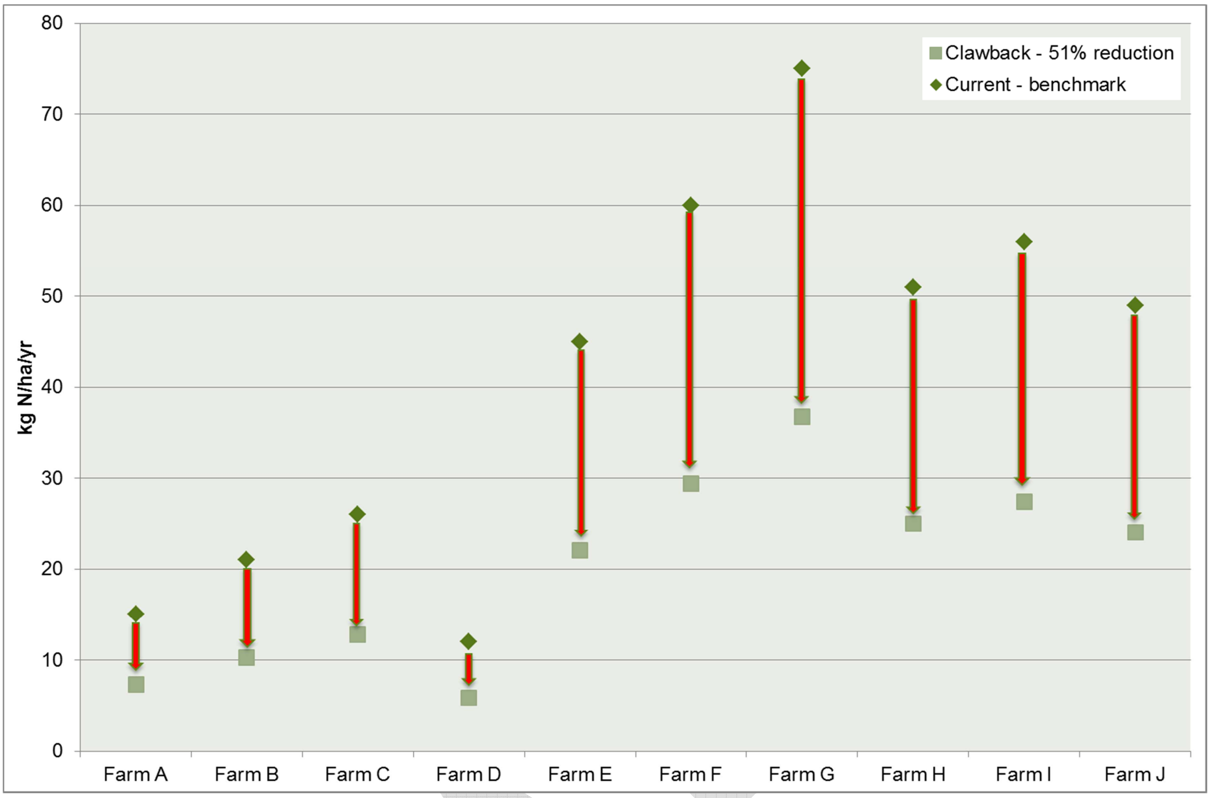


**Figure 3: Reduction required from ten hypothetical farms when allocating using a grandparenting approach, with a 51% reduction applied proportionately across all farms.**

## Implications for the Lake Rotorua catchment

We know the current ranges in nitrogen loss across properties in the Lake Rotorua catchment from the benchmarking work that has been undertaken in implementing Rule 11. These ranges are very broad, both within and amongst sectors [see Figure 2]. For example, dairy nitrogen losses range from less than 20 to over 70 kg/ha/yr, dairy support ranges from 10 to over 50 kg/ha/yr and drystock ranges from less than 5 to over 25 kg/ha/yr.

Applying a grandparenting allocation will result in allowances 51% lower than the current benchmarks for all properties in the catchment. This would 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 36 kg/ha/yr, or 29 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 windfall gain 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
- 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
- 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 varied 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.

**Question for STAG: what do you think the pros and cons are of using a grandparenting allocation approach?**

## 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 achieve a 51% reduction in nitrogen loss. Under sector averaging, Farm 1 that 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. This could result in that farm being unable to continue current activities due to the feasibility of operating at that nitrogen loss rate or by inability to afford the required mitigation.

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.

An analysis of the preference determinants for each allocation option is provided in Appendix 5. Likely characteristics of a farm that will prefer a grandparenting approach are:

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

Likely characteristics of a farm that will prefer a sector averaging approach are:

- low nitrogen loss
- less intensive practices
- lower rainfall
- 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 provided for information as a supporting document.

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 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 X) and the drystock sector (Figure X)

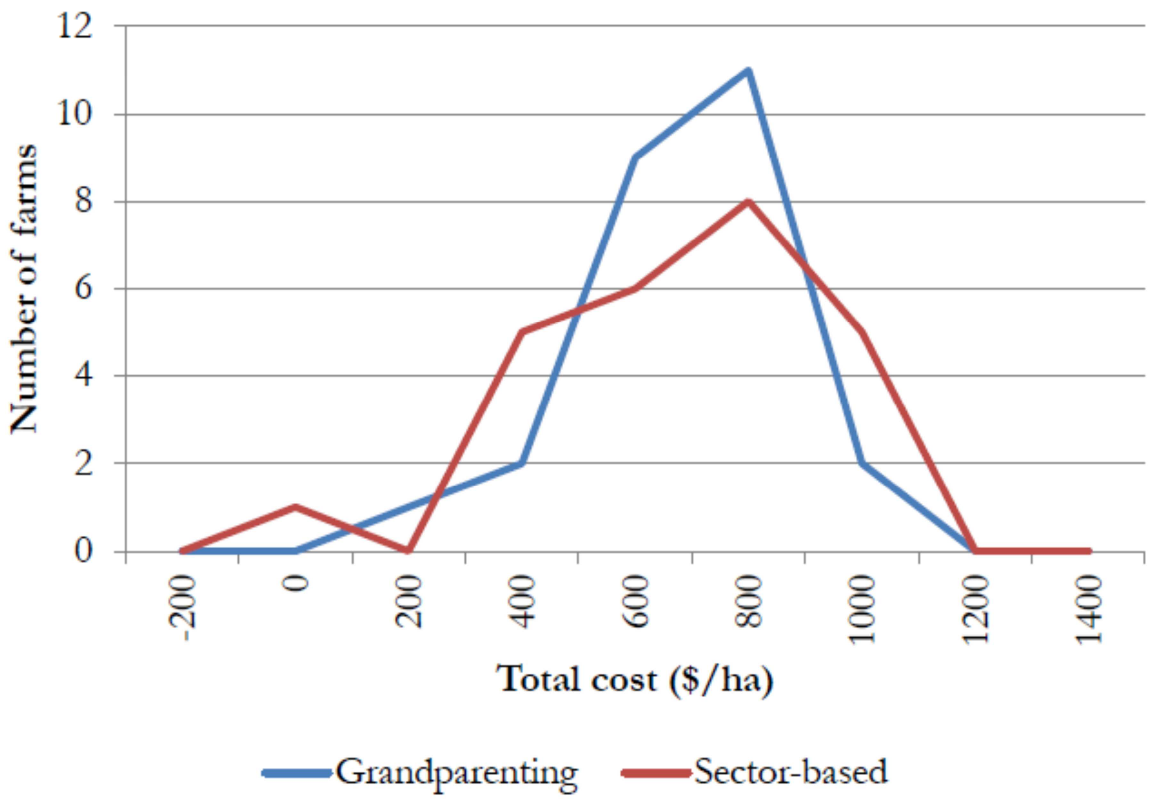

**Figure X: Distribution of total costs for individuals in the dairy sector**

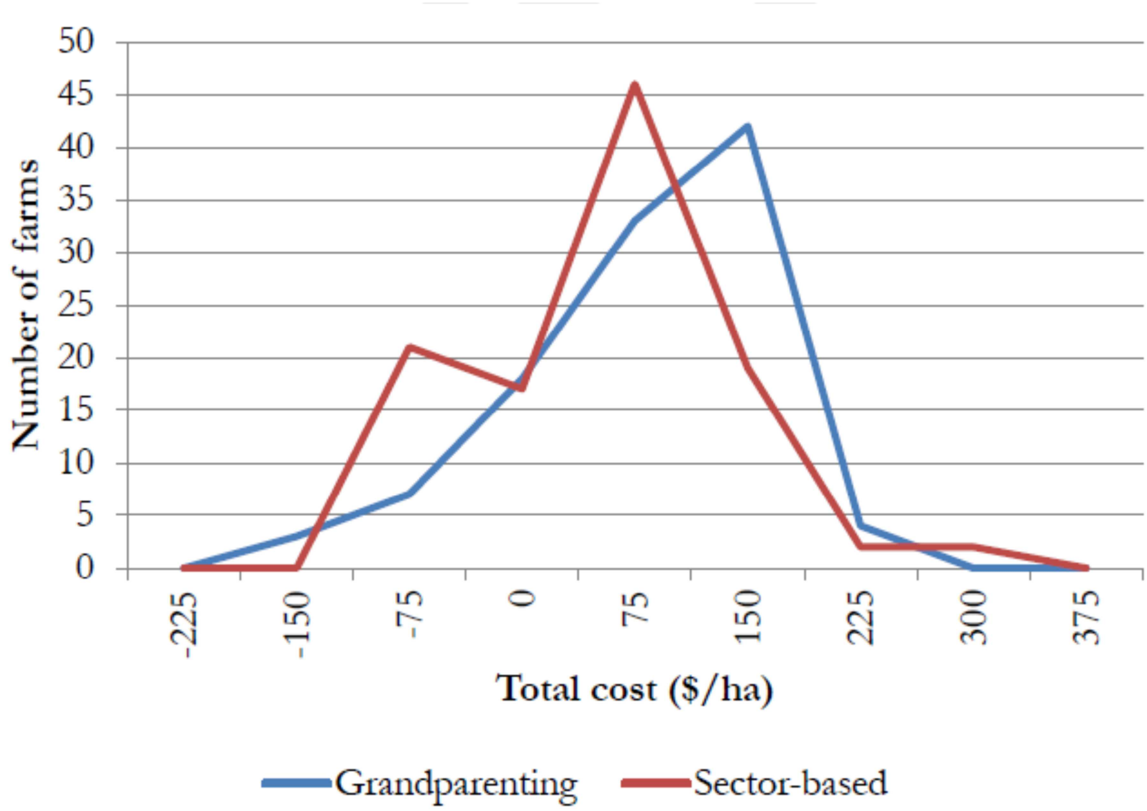


**Figure X: Distribution of total costs for individuals in the drystock sector**

## Issues around costs

The cost of meeting the nitrogen target for the lake is very high. The broad costs associated with achieving the sustainable load have already 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
- 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 the right to

discharge nitrogen to the ground water catchment having a tangible economic value, such as through nitrogen mitigation incentives or compensation

# 5.0 Summary of options analysis

The impact of 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 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 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 in very different ways.

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.

**Question for STAG: do you have a preference for sector averaging or grandparenting?**

## 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 bit less.

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 to be mode through the allocation process which might be considered a fair approach given impacts overall are likely to be significant. [*Note - this will mean there will be some "additional" allowances in the system*].

- Adjusting the sector average allowances proposed. 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*].

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*].

**Question for STAG: are there particular ways you think an allocation approach could be modified to be more suitable?**

***Recommendation 2:*** ***Agree that the preferred approach for allocating nitrogen to land use activities in the Lake Rotorua catchment is either:***

***<u>Option One:</u> sector averaging, using the following sectors and associated averages – dairy @26.5kg N/ha/yr, drystock @ 7.7kg N/ha/yr, forest @ 4kg N/ha/yr;***

***OR***

***<u>Option Two:</u> grandparenting, requiring a 51% reduction from the benchmarked nitrogen loss of every property***

***Recommendation 3:*** ***Provide direction to staff on including any additional modifications to the preferred allocation approach, if required.***

## 6.0 Nitrogen Trading [Incomplete]

Given the scale of reduction required to achieve the sustainable load, the ability to trade nitrogen will be key to enabling landowners to make choices about how they farm into the future.

- Provide an assessment of trading scheme advantages and disadvantages.
- Highlight administrative costs
- Note that specific mention of the value of a trading scheme was made in the Oturoa Agreement

**Question for STAG: do you support a nitrogen trading scheme?**

***Recommendation 4:*** ***Agree to progress the development of a nitrogen trading scheme to support the allocation of nitrogen amongst land use activities***

## 7.0 Implementation issues [Incomplete]

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 load is higher or lower than the current 435t).
- *Monitoring and compliance*. Any management regime that provides discharge allowances to individual properties will need to be supported by a very detailed monitoring and compliance programme. This will be particularly important if a trading scheme is to be successful.

## 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

Recent studies suggest that gorse could be leaching up to 35 tN/yr in the catchment (<5% of the current load). However, while nitrogen losses from gorse are recognised, they are not specifically accounted for. ROTAN for example does not explicitly model nitrogen losses from gorse in the catchment; losses from gorse are simply included through calibration of the model.

Likewise, Rule 11 benchmarks provided using Overseer to calculate the total nitrogen discharge allowance (NDA) for each property in the catchment do not include provisions for gorse. 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 nitrogen loss from gorse, which could be as high as 38kg N/ha.

Because gorse is not specifically accounted for in the lake modelling or benchmarking, removing gorse won't actually be recognised as helping a landowner meet their allocation allowance.

However, it is important to address gorse as best we can for long term improvements in the water quality of the lake. Nitrogen reduction is the key factor for water quality improvements in Lake Rotorua and removing gorse in the catchment is worthwhile in that context.

A position statement for gorse in the Lakes Catchments will be provided to Council for approval on 25 June 2013:

> *Council support for land use change on gorse infested land will be considered where gorse affects water quality.*

This position statement will enable Council to support land use change on gorse infested land, whether through the Incentives Scheme being developed to support land use change in the catchment, or through other incentive funding.

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 [Incomplete]

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.

A large portion of undeveloped land in the catchment is Māori land. 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.

As decisions around allocation progress, two pressing issues for Māori are:

- The implications of land-use restrictions for landowners of underdeveloped land including the issue of gorse cover discussed above
- The potential difficulty for small Māori landowners to take advantage of complex policy

Discuss:

- Extent of issues, including maps
- Potential ways of addressing issues

### 8.3 Unintended Consequences [Incomplete]

- Unfavourable landscape
- Less diverse farm systems
- Insufficient capacity of farmers and farm advisors to implement required change
- Farmers locked in to an allowance that is too high or too low to reach target for the lake
- Politically unacceptable

### 8.4 Risks [Incomplete]

- Insufficient support for a nitrogen trading system, and/or farmers are unable to compete with the public fund to purchase nitrogen
- Fluctuating prices (eg for carbon or nitrogen allowances) giving little certainty to farmers
- Low intensity systems will have less buffer when prices are low
- Unfavourable behaviour eg. Hoarding

## 9.0 Views of the Stakeholder Advisory Group [Incomplete]

Summarise the views of the group if possible.

## 10.0 Next steps [Incomplete]

Identify that:

- This is an in-principle decision
- If they choose an approach we can then develop the rules to support it
- Once the package looks ok we can start the plan change process and send out a draft for consultation.

# Appendix 1: Assumptions and uncertainties in the lakes science and data [Incomplete]

Provide overview of assumptions and uncertainties in:

- TLI setting
- Impact of P
- Sustainable load estimate
- ROTAN
- Land use data: including Overseer versions

# Appendix 2: Planned interventions and associated costs for Lake Rotorua and its catchment

Table 4 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 4: 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 3: Detailed assessment of different allocation approaches by staff and StAG [To be attached]

# Appendix 4: Confirmation of sector averages and allowances

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[8]" in the catchment, each with very different nitrogen loss profiles (see Table 5 below). In contrast, ROTAN has used a far more simplified approach, aggregating many associated land uses together (see Table 6 below).

**Table 5: Block types, area and average nitrogen loss for benchmarked properties in the Rotorua catchment (using the Rule 11 surface water area)**

| Block Type | Area in Overseer | 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 |

**Table 6: Land use types, area and average nitrogen loss modelled in ROTAN for the Rotorua catchment (using the Rotorua catchment groundwater area[9])**

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

It is clear that there are some large variations in nitrogen discharges amongst different benchmarked block types. However, allocating allowances across a large number of different block types is

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

[9] 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.

problematic. This is because individual properties are made up of many block types – for example, a dairy farm will 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*

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)

Staff acknowledge that farm changes may be required in order to continue to provide dairy support (such as part land use change to forestry in order 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*

It is also recommended that the ROTAN "lifestyle" land use be grouped 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.

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 figures that have been used to derive the total nitrogen inputs in the catchment and support the lake modelling that has been key in defining sustainable loads.

# Appendix 5: 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<br>- Weak or no relationship | | | |