IN THE MATTER OF	The Resource Management Act 1991
AND	
IN THE MATTER OF	Lake Rotorua Nutrient Management – **PROPOSED PLAN CHANGE 10** to the Bay of Plenty Regional Water and Land Plan

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STATEMENT OF EVIDENCE OF SANDRA ALISON BARNS
ON BEHALF OF THE BAY OF PLENTY REGIONAL COUNCIL

Evidence topic: Economic and social impacts

Contents:

Qualifications and experience

1. My full name is **SANDRA ALISON BARNS**. I am employed by Bay of Plenty Regional Council as an economist, a position I have held for 3 years.

2. Prior to this I was employed by the Waikato Regional Council (WRC) for nine years, including one year leave of absence (2008-09) working at the University of East Anglia, Norwich, as a recipient of a Marie Curie Fellowship. While in the UK I was part of a project team researching farmer response to the EU Water Framework Directive. At Waikato Regional Council I was involved in policy areas including air quality, geothermal. In 2013 I co-authored a paper reviewing WRC's nitrogen emissions in the Lake Taupō catchment, particularly in relation to the working of the nitrogen market.

3. I hold a Bachelor of Management Studies (Honours), majoring in Economics and Finance and a Masters in Management Studies (Honours), majoring in Economics, from University of Waikato, Hamilton, New Zealand. I am a member and office holder of the New Zealand Agricultural and Resource Economics Society (NZARES) and an office holder on the NZARES Committee.

4. The proposed Plan Change has been an important part of my work since I joined the Bay of Plenty Regional Council.

5. The key areas of my work on the proposed Plan Change have been commissioning research for economic studies, interpreting results of those studies, and as part of the team writing the Section 32 Evaluation Report.

6. I have read the Expert Witness Code of Conduct set out in the Environment Court's Practice Note 2014 and I agree to comply with it. I confirm that the issues addressed in this statement of evidence are within my area of expertise, except where I state I am relying on the specified evidence of another person. I have not omitted to consider material facts known to me that might alter or detract from my expressed opinion.

7. I am authorised to provide this evidence by the Regional Council.

Scope of Evidence and Summary

8. The scope of my evidence covers the economic benefits and costs of the proposed Plan Change, and the social costs where they overlap with economics, in order to provide the Panel with an understanding context policy decisions.

9. Direct economic evidence will be presented by authors of the following four reports that have been important to informing decisions in the proposed Plan Change:

   (a) Perrin Ag (2014). Rotorua NDA Impact Analysis.

   (b) Perrin Ag (2016). Update of the 2014 NDA Impact Analysis.

   (c) Parsons O, Doole G and Romera A (2016). On-farm effects of diverse allocation mechanisms in the Lake Rotorua catchment.

   (d) Market Economics Limited (2015). Economic impacts of Rotorua nitrogen reduction. District, regional and national evaluation.

10. These reports, along with other reports commissioned by the Regional Council, have formed part of the Section 32 evaluation produced by the Regional Council to support the Proposed Lake Rotorua Nutrient Management Rules Plan Change 10.

11. My evidence will focus on the four reports listed above, and on selected other reports commissioned by the Bay of Plenty Regional Council which are referenced throughout the evidence. These are the most relevant of a large number of economic studies undertaken over the past 10-plus years.

The costs of restoring water quality in Lake Rotorua

12. While the Council has only had an economist on staff since March 2014, the Council's Land Use Technical Advisory Group (2004-2007) and later the Land Technical Advisory Group (established 2012) has included agricultural and resource economists. To the present day Council staff maintain professional relationships with external consultants for economic advice and research. Included are experts with practical knowledge of farms and farming systems.

13. In general, economic information has been provided to Council in two main ways. Firstly, research has been commissioned by Council to explore or address specific issues or understand costs and benefits of particular policy approaches, for example, the total costs of the reduction required for the Lake Rotorua (Nimmo Bell, 2011,

Market Economics Limited 2011), and later the feasibility of a two-step approach, which is the rules and incentives funding option (NZIER, 2013). The second way has been through public good research by organisations such as Mōtū and the University of Waikato.

14. Council has commissioned economic work to understand the costs and benefits of tackling the Lake Rotorua water quality issue dating back more than a decade. Examples include a 2004 report from McKinlay Douglas Limited investigating and advising Council about making a case for central government funding to help restore lake water quality, and how costs of restoration might be allocated between different stakeholders. Other early economic work included land use change scenarios for the Lake Rotorua catchment based on restrictions in the total nitrogen from land use activities, and estimated the costs of these restrictions to landowners and the wider economy (Nimmo Bell, 2004). In 2007, Council commissioned a study of winter grazing management practices that could be realistically used to reduce losses of nitrogen and phosphorus into the lake (Taylor and Park, 2007). These are examples from a large body of economic work that has continued as Council has looked for ways and explored costs of improving lake water quality.

15. In 2011, when the Trophic Level Index (TLI) of Lake Rotorua was 4.8, Council commissioned a major report that provided the nitrogen reductions and economic costs of three scenarios, each reducing the annual load of nitrogen to the lake by 300 tonnes. Three land use change scenarios portrayed different patterns of reduction or conversion of high nitrogen land uses such as dairy farming, to lower nitrogen land uses, such as forestry. The land use changes were modelled over 10, 25 and 50 years implementation periods. This research, which was a complex mix of economics and science, demonstrated the level of land use change and investment that would be required to achieve the TLI 4.2 target and the costs to the wider economy in the absence of funding (e.g. the incentives fund).

16. The Lake Rotorua Stakeholder Advisory Group (StAG) was set up in late 2012. Economic reports commissioned through or reported to StAG have included types and costs of nitrogen mitigations available to farmers[1], the impacts on farm profitability[2], the economic impact on farms and the wider economy under different

[1] Perrin Ag (2012). Farmer Solutions Project. The Lake Rotorua Primary Producers Collective initiated this report, which was funded by BOPRC.
[2] Perrin Ag (2014). Rotorua NDA impact analysis. Phase 1 project.

allocation scenarios[3], the attributes of alternative nitrogen allocation methods, systems for trading nitrogen allowances[4], and small blocks in the catchment[5]. The Council also commissioned a report on the impact of the proposed Plan Change on land values in the Lake Rotorua catchment[6].

17. The following key economic reports were commissioned throughout the StAG process, and form an important part of the economic evidence to be presented:

(a) Perrin Ag (2014). Rotorua NDA Impact Analysis. The purpose of this research was to gain a better understanding of the likely costs of the Nitrogen Discharge Allowance (NDA) policy at farm level. The research assesses the potential for farms to reduce nitrogen discharges and the impact on operating profit for eight dairy farms and 10 drystock farms. The farms were a mix of real and hypothetical case studies broadly representative of farm systems in the catchment. Nitrogen discharge ranges of 30-40kgN/ha/year (dairy) and 10-20kgN/ha/year (drystock) were based on Overseer 5.4.11. In this research the farming strategy could change to reduce nitrogen and/or increase profitability (e.g. change in ratio of beef to sheep). Product and input prices were averages for the 2013/14 year, except for the milk price which was set lower at the medium term milk price of $6.60/kg MS. [Refer evidence of Lee Matheson].

(b) Perrin Ag, 2016. Update of the 2014 NDA Impact Analysis. This report was commissioned by Council to update the 2014 report, using the figures now available for individual farm provisional NDA, updating to Overseer 6.2.0, and revising medium term pricing expectations (the milk price was revised down to $5.50). Perrin Ag was also asked to identify gaps in the case studies within the allocation range for each sector. The case study farms were analysed for their ability to reduce nitrogen leaching down to a provisional NDA while remaining profitable. [Refer evidence Lee Matheson].

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[3] Timar L, Anastasiadis S, Kerr S (2013). Modelling the free allocation of nutrient discharge allowances among heterogeneous farmers in the Lake Rotorua Catchment (Draft). Mōtū Economic and Public Policy Research.

[4] Connor R (2014). Nutrient trading in the Lake Rotorua catchment; Connor R (2014). Options for trading nitrogen discharge entitlements in the Lake Rotorua catchment; Connor R (2014). Rotorua Lakes nutrient trading working paper.

[5] Land Connect Limited (2015). Lake Rotorua catchment small block sector review. Report prepared for the Bay of Plenty Regional Council.

[6] Telfer Young Limited (2015). Land values in the Rotorua area and the Lake Rotorua catchment.

(c) Parsons, Doole and Romera (2015). On-farm effects of diverse allocation mechanisms in the Lake Rotorua catchment. This analysis was commissioned by StAG to estimate the economic impacts and distribution of costs of different allocation methods. Eight allocation scenarios were modelled, as agreed through StAG. The modelling results were important in assisting StAG's discussion and decisions about allocation (discussed below). The modelling was based on Overseer 6.1.3. Different levels of nitrogen discharge allowance trading were tested to provide costs under different trading scenarios. Assumptions included medium term pricing expectations, including a MS price for dairy of $6/kg. [Refer evidence of Professor Graeme Doole]

(d) Market Economics Limited (2015). Economic Impacts of Rotorua Nitrogen Reduction. District, Regional and National Evaluation. The purpose of this analysis was to estimate the cost of different allocation options to the district, region and nation. This analysis followed on from the Parsons et al report, and used the output from that modelling. Three allocation scenarios were modelled; single sector target, natural capital, and sector range. Market Economics were also asked to consider benefits, such as those to the tourism sector. As with the work by Parsons et al. this work was useful in understanding the wider implications of different allocation choices. [Refer evidence Dr Nicola Smith].

18. It is important to note with the Parsons et al (2015) and the Market Economics Limited (2015) reports that they provide projections for a future date after the changes from the proposed policy has worked through and the catchment reaches a post-policy equilibrium. They don't attempt to show the transition to this new state.

The wider economic context

19. Deterioration of Lake Rotorua water quality began in the 1960s and has been the subject of concern since then [refer evidence Andrew Bruere and Stephen Lamb].

20. In economic terms, the impact of deteriorating water quality (increasing nutrient levels or eutrophication) in Lake Rotorua is primarily a negative externality, which occurs when an individual or firm undertakes an activity that imposes uncompensated costs on others. In the 1970s and 1980s, the local council applied costs for sewage treatment to the local community. Although sewage treatment and disposal has

changed, externalities imposed by past and current agricultural practices remain as the current issues.

21. The social and cultural costs to the wider community include perceived negative changes to the look, smell and feel of the lake [Refer para 78 onwards], reductions in enjoyment of recreational activities such as boating, swimming, wading, and fishing, loss of cultural values such as the mauri of the Lake, and economic costs for sectors dependent on the lake – such as tourism [Refer evidence of Dr Nicola Smith].

22. While effort continues to reduce the sources of nutrient to the Lake, the heavily nutrified lake and subsequent poor water quality are managed by dosing the lake (via streams) with alum [Refer evidence of Andrew Bruere]. The cost of alum dosing ($500,000/year) is shared by taxpayers and ratepayers.[7] In any year should dosing fail to manage sediment nutrients, algal blooms may develop, and the associated economic and social costs such as amenity values and tourism reductions will be shared by the wider community. As alum dosing is only a temporary 'fix' the risk associated with failure is impacted on current and future generations. This raises the question of what constitutes an appropriate measure of water quality that may address generational effects.

The trophic level index

23. The other evidence filed on behalf of Council provides an explanation of the way that the community contributed to the setting of the operative TLI [see Bruere, Lamb]. From an economics perspective, the main points I would like to make are that the TLI went through a full Schedule 1 process, and to that extent, reflects the community decision on how much negative externality is acceptable – for Lake Rotorua the TLI was set at a point that required improvement in water quality.

24. Objective 10 in the operative Regional Water and Land Plan establishes the TLI for Lake Rotorua at 4.2. The TLI levels for the Rotorua Lakes were consulted on in late 2001 prior to notification of the Plan, and again through the submission process in 2002-03 when Council received eleven submissions on the TLI objective. Four submissions sought removal of the TLIs for the lakes, while seven supported them. In

[7] In the year to March 2015 the cost of liquid aluminium sulphate delivered to BOPRC was $536,000. This does not include the cost of dosing the streams. This is a Deed Funded intervention, and so 50% is funded by taxpayers (central government funding), 25% is a general rate across the Bay of Plenty region, and 25% is a targeted rate for Rotorua ratepayers.

2004 a Hearings Committee considered these submissions and recommended that Council retain the TLIs as they appeared in the Plan.

25. In addressing the negative externalities (primarily sources of nutrients currently flowing into the lake) Rule 11 of the operative Regional Land and Water Plan set benchmarks for farms in the Lake Rotorua catchment at the average of 2001-2004 nitrogen leaching levels. The proposed policy is considered from the status quo – the Rule 11 benchmarks.

26. The Rule 11 benchmarking process provides the starting point for reduction [see Lamb] and reflected the position that the costs of a cleaner lake would include no further development or intensification that increased nitrogen loss (other than via consent). That economic signal has been in place since Rule 11 was introduced in 2005, and was followed by the RPS, notified in November 2010, and made operative in 2014.

Land use in the catchment

27. In terms of the district, the number of dairy farms and drystock farms in the lake catchment is about 12% and 30% respectively of the district. Livestock numbers are of similar proportions to the number of farms.

28. Deer farming has been important in the Lake Rotorua catchment in past years, but the changing economics has reduced the number of deer farms. This is a national trend. In late 2015, I investigated deer farming in the Lake Rotorua catchment. At that time there were 13 deer farms fully in the catchment. Of these, 11 were greater than 10 hectares and seven of those farmed deer exclusively.

29. As part of the investigation I contacted the two major processors of deer products in the Rotorua district. The processors source very little of their product from the local deer farmers, and so are situated in Rotorua for other reasons. Over the past 10 years three Rotorua-based deer product businesses have ceased operation, aligned with a general decline in deer farming in Rotorua district and across New Zealand.

30. The Perrin Ag 2014 report included a deer farm (venison) case study deer for its ability to reduce nitrogen. The analysis suggested that the farm could achieve the reduction in nitrogen and improve profitability. While these results cannot be extrapolated across all deer farms, it suggests that deer farms may be like other pastoral farms, with a range of impacts that are farm dependent.

31. The Parsons et al. analysis omitted deer farming as a single sector in the economic model, considering that the complexity involved in the inclusion of the relatively small and heterogeneous sector would outweigh the benefits. Instead the hectares in deer farming were included as drystock in the economic model.

32. Deer farming is a relatively low nitrogen leaching activity. Deer farmers I contacted reported that deer fencing remains on ex-deer farms, so there is potential to re-enter the industry should the economics of deer farming improve.

33. Small blocks (<40ha) are a feature of the Lake Rotorua catchment. The approximately 1,400 small blocks cover 5,600 hectares, making up 13% of total rural land. Most (70%) small blocks are less than 4 hectares, covering 1,104 hectares. Drystock is the most common effective land use on small blocks (90%, 3755 ha), followed by dairy support (6%, 265 ha).

34. The quantity and diversity of small blocks make it difficult to connect meaningfully with small block owners. Research indicates that while the majority of small block owners are engaged in some form of production from their land, generally this is not the sole support of their households. Of the 1,045 small blocks of less than 4 ha, just 2% are registered for GST.

35. The area in small blocks was represented in the economic modelling (Parsons et al. 2015) as low productivity drystock farms. In the model small blocks were constrained in terms of land use change to unrealistic land uses, such as forestry.

36. Potentially, enabling nitrogen discharge allowances to be transferred (traded) in the Lake Rotorua catchment can lower the overall costs of achieving the 435t sustainable limit. For example, farmers who have high mitigation costs can purchase nitrogen allowances if they are cheaper than mitigating, while farmers who have lower costs of mitigation can mitigate and sell their allowances. Where farmers cannot trade each farmer must mitigate regardless of the cost.

37. In modelling the Lake Rotorua catchment, Parsons, Doole and Romero tested different assumptions about trading to test the sensitivity costs and actions to levels of trading. The modelling results confirmed that the ability to trade reduces the overall cost of achieving the required reductions. However, landowners may make decisions not to change land use (such as dairy to forestry), or to hold allocation for ‘insurance’ in case the nitrogen is required in the future.

The Regional Policy Statement

38. The RPS framework is described in Stephen Lamb's evidence. The RPS (Policy WL 5B) requires allocation (to land use) of the assimilative capacity of the lake regarding nitrogen. Some of the principles and considerations with respect to allocation are economics based, including:

(a) Extent of immediate impact

(b) Public and private costs and benefits

(c) Resource use efficiency

(d) Existing of farm capital investment; and

(e) Ease of transfer of the allocation

These considerations have informed Council's decision to undertake the level of economic analysis to date. This analysis is set out in the evidence of Dr Nicola Smith and Professor Graeme Doole, which I have coordinated.

Capping nitrogen and enabling transfer

39. A policy option to allocate for an environmental good or service (assimilative capacity of the lake) with a cap (435t N leaching), and allow for the transfer of rights is termed a 'cap and trade' system. It sets up a trading market by setting parameters and enables individuals to make business decisions within those parameters. This approach assumes that people respond to economic imperatives with market-based policy options cheaper and easier to administer than non-market alternatives. It also recognises that farmers are better at making decisions about their business operations than government agencies. However, an environmental cap and trade system does move an open access resource into a private property rights system with attendant problems of determining and administering property rights. By comparison, regulation is a non-market policy option, where government might limit the number of livestock per hectare, the kg of chemical fertiliser per application, per season, how, where and when effluent is spread, and other factors that contribute to nitrogen leaching.

Allocating rights to discharge nitrogen[8]

40. Alternative ways to allocate nitrogen was a key discussion topic for StAG in early 2013. StAG developed principles in addition to those in the RPS, including the following economics-based principles:

    (a) Preference given to the allocation approach that has the least overall economic impact.

    (b) Existing investment (including in infrastructure, land value, cash investment and in nutrient loss mitigation) will be recognised.

    StAG's principles also included not rewarding high nitrogen loss practices relative to sector norms, which would serve to limit the top end of nitrogen use/loss within sectors, and ensure windfall gains would be minimised.

41. In February 2013, Mōtū staff presented the results of economic modelling on sector averaging and grand-parenting allocation in the Lake Rotorua catchment (Mōtū, 2013). Findings demonstrated that benchmarked properties differed in nitrogen leaching due to farm management practices and to geophysical factors outside the farmer's control (e.g. soil type, rainfall). In March 2013, StAG discussed nutrient allocation as a special topic in a 2 hour session facilitated by Suzie Greenhalgh, economist, Landcare Research. Seven allocation methods were considered, including sector averaging. Broad agreement was reached to develop a hybrid allocation method based on sector averaging with ranges. Important arguments for sector averaging are that it would not reward high discharges relative to sector norms, and would not provide windfall gains.

42. In July 2013 The Primary Producers Collective (PPC) tabled the report *'Draft Alternative Lake Rotorua Catchment Nitrogen Policy'* at StAG (Primary Producers Collective, 2013). This paper proposed sector range allocation, with sector averages of 35khN/ha for dairy, with a range of 30-40 kgN/ha, and drystock 13kgN/ha, with a range of 9-17kgN/ha. It must be noted that the paper included a disclaimer that it was not an endorsed PPC position. The Collective's proposal was accepted by StAG as a framework for a StAG Position Paper to Council in September 2013, representing a

[8] Refer evidence of Stephen Lamb for more detail on this process.

‘collaborative solution’ that endorsed the sector allocation approach as the preferred allocation option.[9]

43. In July 2015 nitrogen allocation methods were again considered, and the proposal for the ‘Catchment Economic Impacts Analysis’ was presented by Oliver Parsons, DairyNZ.[10] The proposal to undertake this study was further developed and refined through StAG, and set out a participatory approach to the catchment modelling by Parsons, Doole and Romera, and the district and regional economic analysis by Market Economics Limited.

44. Differences between the proposal provided in Appendix 1 and the eventual report was the addition of two alternative sector range scenarios, and the representation of trading in the model. The proposal includes fully efficient trading, two levels of less efficient trading, and one scenario with no trading. In a review of the proposal, a criticism was the inclusion of inefficient trading. While acknowledging that the trading market will not work perfectly, the suggestion that farmers would never trade was questioned.

45. A committee was formed to advance this project, comprising Oliver Parsons (DairyNZ), Ben O’Brien (Beef and Lamb NZ), Gwyn Morgan (Federated Farmers), Alvaro Romero (DairyNZ) and myself, (Sandra Barns (BOPRC). Representative farms and mitigation protocols were agreed through workshops (as described in the proposal). Workshop participants included committee members, plus Andrew Burtt (Beef and Lamb NZ), Mark McIntosh (AgFirst), and Lee Matheson (Perrin Ag).[11] StAG received updates on progress from the committee, and preliminary results were presented at StAG meetings by Oliver Parsons.

46. Professor Graeme Doole and Alvaro Romera presented the final report on catchment modelling in April 2015 [Refer evidence of Professor Doole].

47. As an extension to the farm and catchment economic modelling, Market Economics Limited was asked to model the farm-level impacts at the district, regional and

[9] Lake Rotorua Stakeholder Advisory Group (2013). Lake Rotorua Stakeholder Advisory Group (StAG). Position Paper – Allocation rules and incentives. Position paper prepared for the Bay of Plenty Regional Council Meeting 17 September 2013. Objective File Ref A1675666.
[10] Refer Appendix 1.
[11] Not all people attended every workshop.

national level.[12] Three allocation options were analysed, covering the interests of StAG and a range of modelled outcomes (lower cost to higher cost):

(a) Sector average (single target)

(b) Natural capital allocation

(c) Sector range[13]

48. Dr Nicola Smith will present to the Hearings Committee on the methodology and findings of this research. Dr Smith's work included an estimate of potential costs to tourism, should poor lake water quality result in fewer visitors to Rotorua, or to less time spent by visitors in Rotorua. The inclusion of tourism recognises the value to visitors of a clean lake and was used as an indicator of the potential cost of not addressing water quality[14]. A key point made in respect to these potential impacts is that the benefits of a clean lake occur in different industry sectors (e.g. accommodation and food and beverage sectors) to the costs (mainly agricultural sectors), and vice versa for the status quo.

49. A key result from the modelling of Parsons et al. and Market Economics Limited is that regardless of the allocation, if trading is 100% efficient then the land use will reach the same equilibrium and output for the catchment will be the same. At an individual level, different allocation creates different distributions of wealth. Where trading is not efficient costs tend to increase because individuals made decisions for non-economic reasons (or reasons that are not inputs in the model).

The timeframe for reduction

50. By 2022, 70% of the nitrogen leaching reduction must be achieved (RPS Policy WL 6B), of which 100t will come from the purchases of nitrogen discharge allowances by the Incentives Board. At that time, farmers will be required to reduce 42t collectively through management changes identified in Farm Nutrient Plans. By 2032, the 435t annual target must be achieved.

[12] This is Item 11 in the proposal provided in Appendix 1.
[13] The sector range modelled by Market Economics Limited was one of those in the Parsons et al. report, referred to in that report as Sector Range (1)
[14] This should not be misinterpreted as estimating the benefits of improving water quality through the proposed rules.

51. Meeting nitrogen reduction requirements will require farm management changes. The policy timeframe will assist the need to address the knowledge gap that is likely to exist regarding farmer ability to implement mitigations.

52. The Parsons at al. (2015) and Market Economics Limited (2015) analyses are based on medium term prices for inputs and outputs, current farm practices, currently available mitigations in evaluating the future outcomes of nitrogen reduction policies. Both models look into the future and provide an estimate of farm, district, regional and national level impacts at some time post 2032 when the policy changes have worked through, and landowners have made decisions in response to those policies.

53. An important limitation of these studies is that they represent the world as it is right now. For example, forestry is the only low-nitrogen land use option available. Farm input and output prices are current medium term pricing expectations. However, changes in prices could change landowner decisions, leading to different outcomes. New technologies to reduce nitrogen leaching and a wider suite of land use options would change the costs of meeting nitrogen targets.

54. Farming is dynamic and responds to economic incentives. For example, high milk prices since 2007 have seen the dairy sector expand across New Zealand. In the 10 years to 2015 the number of dairy cattle in New Zealand increased by 28%, made up of a modest 3% (106,000 dairy cattle) increase in the North Island, and a major 97% (1,311,000 dairy cattle) in the South Island. Over this period the number of sheep reduced by a quarter, beef cattle and pigs fell by one-fifth, and deer numbers fell by a half. It is unlikely that an economic analysis in 2006 would have predicted the current situation.

Balancing public and private costs and benefits

55. With the RPS setting the nitrogen targets and guiding allocation, the Council must determine how to allocate nitrogen based on what is a fair balance of public and private benefits. Economics can't identify the 'correct' answer, but will identify the costs and benefits of alternative options, and where those fall, thereby contributing to the decision about what is a fair balance.

56. The Integrated Framework[15] shares the costs of reducing nitrogen between farmers, and the national, regional and local communities. Of the 270 tonnes of nitrogen to be

[15] See explanation in evidence by Stephen Lamb.

reduced, the StAG Position Paper presented to Council (September 2013) confirms the tonnage, the programme and accountability:

- 140t through the Rules Programme (farmers)
- 100t through the Incentives Fund (Regional Council)
- 30t through the Gorse Re-vegetation Programme (Regional Council)

57. Private costs associated with allocation include cost of implementing changes imposed, initial reductions, mitigation costs, and limits on future land flexibility. Private benefits include certainty for land owners, opportunities for development and land use intensification and improved efficiency of use of resources.

58. The district economy work by Market Economics Limited highlighted the potential positive (or avoidance of negative) effects from a clean lake for tourism [Refer evidence Dr Nicola Smith].

Impact on farm incomes and farmer debt

59. The allocation option chosen is important in limiting the disruption to farmers and the community. While grand-parenting allocation would have the least disruption because it is most similar to the status quo, it was also seen to reward high polluters. This suggests it may be inconsistent with the principle of equity and fairness (RPS, Policy WL 5B), and it would be inconsistent with the StAG principle of not rewarding practices that cause high nitrogen loss, relative to sector norms.

60. The sector range allocation, which is similar to grandparenting, pulls farms above and below the specified range into that range. In terms of the principles and considerations in the RPS, the sector range allocation provides the best outcome in terms of considering the extent of the immediate impact, taking into account the existing land use and existing on-farm capital investment, while still achieving the reduction in nitrogen discharges required. Similarly it is aligned with the StAG principles of having the least overall impact and recognising existing investment.

61. The two studies by Perrin Ag and the modelling by Parsons et al. provided Council with information about the effect on farm incomes, and to some extent, implications for debt servicing:

62. Perrin Ag (2014) analysed eight dairy farm case studies. All were able to achieve the target range of 30-40kgN/ha with changes in farm practices, but in each case there was negative effect on EBIT (earnings before interest and tax). The cost range per kg of N reduced was from -$0 to -$10. Of the 10 drystock farms assessed, six were able to achieve the range of 10-20kgN/ha and increase profitability. Four farms reduced to the range with a negative effect on EBIT. For those farms, the cost range per kg of N reduced was from -$2 to -$40. Two of the farms with high costs were dairy grazing which the report identified are likely to be among the most affected in terms of managing to meet the N reductions required. [Refer evidence of Lee Matheson].

63. Perrin Ag (2016), reported on six dairy farm case studies and identified that two were able to achieve their provisional NDA and increase profitability by changes in farming practices, such as reduction of supplementary feeding and application of nitrogen fertiliser. One farm achieved the provisional NDA but at a cost of $3/kgN. Three farms fell short of achieving their provisional NDAs by reasonably large margins. These farms would have to invest in infrastructure such as feed pads or purchase nitrogen discharge allowances if they were to remain in dairy farming in the long term. The ability to do this is likely to depend on the gap between their allocation and the level they are able to reduce to in their current farming situation.

64. Results differed across the seven drystock farms studied, but tended to be more positive than those for dairy farms. Two drystock case studies were already at their provisional NDAs, and a further three could achieve the provisional NDA. All five were able to improve profitability with changes in practices, while reducing nitrogen leaching. Of the two drystock farms unable to achieve their provisional NDAs, both were dairy grazing farms. Options for them would include reductions in cattle numbers, increasing pasture exported as supplement, or purchase/lease of NDA. The costs associated with these options were not modelled. Matheson notes that the mid-range of dairy farming (in terms of NDA allocation) and the high range of drystock were not well represented in the study [Refer evidence of Lee Matheson].

65. Parsons et al. (2015), illustrates three hypothetical farm case studies. Dairy farm 1 in a high rainfall zone (pumice soil), and is required to reduce nitrogen leaching by 37% (to 53kgN/ha). Mitigations do not reach the level required, and purchasing NDA is not economically feasible. The option for land use change is taken, moving to dairy support, and selling excess NDA. This increases farm EBIT by 13%. Dairy farm 2 in a high rainfall zone (podzol soil) identifies the best economic option is to purchase NDA, which results in a 4% loss in EBIT. Dairy support farm 3 (podzol soil), is classified as

drystock in terms of allocation. It is required to reduce nitrogen leaching by 34% (to 19kgN/ha/yr). For this farm the best option is to purchase NDA. In doing so EBIT reduces by <1%.

66. Parsons et al. (2015, p24) note that while there are some win-win outcomes for the Lake Rotorua catchment, where elimination of unprofitable input use can reduce N leaching and result in increased profitability, generally the scale of such gains is limited, and 'beyond what could be achieved without imposing cost on at least some farmers in the catchment.' [Refer evidence of Professor Graeme Doole].

In summary

67. The case studies (Perrin Ag 2014, 2016) and the modelling (Parsons et al. 2015) are consistent in that the analysis of each show that the financial impact on farmers will differ across and within farming sectors. Notwithstanding that the case studies and modelling used different versions of OVERSEER® and different prices, the pattern of results remains the same. A small number of farmers are likely to be able to make changes in their farm systems that increase profitability and achieve their nitrogen reduction targets. Some farmers will be able to achieve their nitrogen reduction target within their current farming system. Other farmers will be able to achieve the reduction by changing their land management practices. Some farmers will be faced with more difficult choices – purchasing nitrogen discharge allowances, making more costly investments such as stand-off pads, accepting less income to remain in the same farm type, or changing land use and selling allocated allowances.

68. Council has limited information on farmer debt, and typically farmers do not share this information with the regional council. From the results shown above, the impacts on debt servicing will differ across farmers, however the ability to raise debt may be limited by changes in land values (discussed below), and the extent to which farmers can increase production in 'good' years may impact on debt servicing. Perrin Ag (2014) notes that while EBIT provides a useful measure of system resilience to N loss restrictions, the extent of commitments on farm businesses lie outside the operating profit measure and so the extent that farmers will be affected is difficult to determine.

69. The implications of property values for farmer debt are discussed below with property values.

Support for farmers

70. The Advice and Support Fund and the Low Nitrogen Land Use Fund are mechanisms to assist farmers to achieve their nitrogen discharge targets.

71. The Advice and Support Fund ($2.2m) provides advice from agricultural professionals to assist farmers to develop Nutrient Management Plans to reach their NDA. This is contributed to by national taxpayers (50%), and regional/local ratepayers (50%).

72. The Low Nitrogen Land Use Fund ($3.3m) is available for low nitrogen land use trials directed at sustainable farm system improvements. This is contributed by national taxpayers (50%), and regional/local ratepayers (50%).

Property prices

73. Property price is important as security against debt, a store of value, and for its ability to capture (untaxed) capital gain.

74. In considering property values as security for debt, Parsons et al. (2015) used the modelled cost of nitrogen multiplied by the kg reduced as the difference in property value, based on the idea that a farmer could purchase the nitrogen reduction for the modelled price. Using this method, under a sector range allocation, the estimated change in property price was -$319/ha (1.6%) for dairy land and -$79/ha (0.5%) for drystock land (assuming 50% trading efficiency with unlimited land use change). When trading was assumed to be efficient but land use change was limited to 5,000 hectares, the price change was assessed at -$627/ha (3.1%) for dairy and -$156/ha (1.1%) for drystock.

75. These modelled figures are considerably less than estimates provided by Telfer Young Limited (2015), Rotorua valuers and property advisors. The Bay of Plenty Regional Council commissioned Telfer Young Limited to assess the possible impact of Plan Change 10 on prices of properties in the Lake Rotorua Catchment relative to properties outside the catchment and not affected by nitrogen-related rules. The low volume of sales meant the assessment relied largely on expert opinion.

76. Telfer Young Limited (2015) considered that ‘Rule 11’ had a general negative impact on property prices of around 15-20% for dairy farms and 15-25% for drystock, depending on the property characteristics such as contour, size, productive capacity and potential for other uses. For example, steeper land that is unsuitable for dairy will be less affected than land that could have been converted, and farms closer to the lake and able to be subdivided are likely to be less impacted than those without

subdivision potential. Property characteristics will affect changes as a result of proposed Plan Change 10, and the price impact will depend on allocation method, and could be:

- 10-15% reduction for dairy farms.
- Approximately 10%-25% reduction for larger lifestyle blocks where commercial potential is reduced by allocation.
- Negligible for lifestyle blocks with no economic return.

77. Changes in property prices depend on economic potential. For example, the best value for a property with lake views might be subdivision, in which case the impact of Plan Change 10 on capital value might be positive where it is perceived that an increase in water quality is an improvement. Telfer Young Limited noted that uncertainty creates a greater price differential, and was likely to impact on decisions to buy or sell. At the time of the report the recommendation for allocation had not been formally made to Council by StAG.

Social costs and benefits

78. The Bay of Plenty RPS Policy WL 2B defines the catchment of Lake Rotorua as a catchment at risk; Policy WL 3B sets the limit of nitrogen entering Lake Rotorua at 435t/year, based on achieving the TLI of 4.2; Policy WL 5B requires the allocation of capacity to assimilate capacity, providing principles and considerations for this process; Policy WL 6B requires the managed reduction of nutrient losses, including by way of rules. This policy also sets the key dates for Lake Rotorua of 70% of reduction required by 2022, and no discharges that exceed the limit of 435t/year beyond 2032.

79. In 2011, a social and economic impact assessment was undertaken for the RPS with particular emphasis on the water and coastal policies. The assessment included:

- Comments from feedback on the draft RPS
- A high-level literature review of social and economic impacts of New Zealand water and coastal management initiatives
- A demographic and population profile of the Bay of Plenty
- Key informant interviews (telephone and face to face). Interviewees were:

- Māori and other community stakeholders
- Territorial authority stakeholders

80. The social costs highlighted in the report and relevant to Plan Change 10 were:

- Impact of pollutants in waterways, and cost to community of dealing with water pollutants
- Recreation and food gathering
- Health impacts
- Cultural concerns relating to degradation of the water environment

81. Interviewees also raised concerns about:

- Supporting the rural economy
- Potential constraints on economic development through limited dairying, particularly for Māori landholders
- The practical implementation of the policy

Social implications of costs

82. The economic costs of improving water quality accrue to landowners in the catchment through land use and land management changes, and to the community through taxes and rates. The landowner costs fall unevenly on individuals, while community costs are spread across a large number of households. The size and distribution of economic costs will be linked with social costs, particularly for the lake catchment community. Decisions about where costs fall will have social implications, including perceptions of fairness, community relationships and social wellbeing (Mōtū, 2009).

83. Of this quandary, Motu (2009, p.1) states:

There is no 'correct' answer to the question of who should pay. The 'best' answer for Lake Rotorua will depend on what the community thinks is fair and what will be politically feasible.

84. Policies in the RPS help to mitigate the social costs associated with improving water quality through the timeframe for reduction (to 2032), principles and considerations for

allocation of nitrogen, and requirement to consider the equitable balancing of public and private costs and benefits. The latter is achieved through the Integrated Framework [Refer Stephen Lamb evidence].

85. However, given the scale of reduction required, some social disruption is inevitable, and is likely to include land sales and land use change to less nitrogen intensive uses. Land use practice improvements will be required, and farmers and farm workers are likely to have to upskill to achieve this. Employment is likely to shift within and across sectors. Employment in agricultural and related sectors within the catchment will reduce, while employment in forestry increases as a result of land use change. Where water quality affects tourism, service sectors such as 'accommodation' and 'food and beverage services' are likely to benefit [refer evidence of Dr Nicola Smith].

Changes in land use and land management practices

86. For context, the city of Rotorua is at the southern end of the lake (Appendix 2). Dairy farming is concentrated in the north-western corner of the catchment, with other isolated pockets of dairy spread around the catchment. Except for some dairy land at the north of the lake, the dairy tends to be on the outer areas of the catchment. Drystock farming tends to occur throughout the catchment. Areas of forestry are in the north-western and south-eastern areas in the catchment; lifestyle blocks are concentrated in areas on the western and north-western sides, and on the eastern side of the lake.

87. Changes in land use will be driven by the cap on nitrogen, which is necessarily less than the level that is currently discharging into the lake. While the Integrated Framework shares the costs, landowners will be required to reduce 140 tonnes of nitrogen between now and 2032. At an extreme this will require changes in land use. Modelling suggests that the highest proportional reduction will be from dairy farming (about 45% of area on the 26 dairy farms), and much will convert to forestry (Parsons et al. 2015). In addition about one-third (37%) of sheep and beef farming is expected to change to a low nitrogen land use.

88. Modelling suggests the amount of forestry in the catchment will increase by about 3,000 hectares, much of this from dairy farms. Dairy farms tend to sit on the outer edges of the catchment, where changes are likely to have a lesser impact on the look and feel of the lake. However, the model is limited by its inputs which are based on

current land uses and practices. Forestry is the only low nitrogen land use modelled, and so can be the only result in modelled land use change.

89. Sector range nitrogen allocation supports current emitters and in this way helps to reduce landowner adjustment costs. However, as noted above, the required reduction of nitrogen means that some level of social disruption is unavoidable. The policy objective cannot be achieved without land use and land management change.

90. Given this, the Council recognises that landowners will require support, and the Integrated Framework is geared towards mitigating the economic and social impacts, while still achieving the reduction required to the sustainable nitrogen limit. Outside of nitrogen reduction purchases by the Incentives Fund, the timeframe for the policy is such that landowners are able to take time to consider options that will be best in their specific situation. The Advice and Support Fund is available to assist landowners with planning (Nutrient Management Plans) to reach their individual nitrogen discharge allowance, and the Low Nitrogen Land Use Fund supports trials that may lead to alternative ways of meeting the proposed rules.

91. The Market Economics Limited research suggests that the proposed policy is likely to result in job losses in the agricultural sectors. The extent of this depends on the allocation method for nitrogen discharge allowances, and the level of trading of allowances. Alongside changes to pastoral agriculture, jobs in forestry increase. These changes are based on the economy and the environment as it currently is. Economic changes may result in alternative industry sectors or farming approaches that increase employment. In the absence of the proposed policy, negative environmental events such as a toxic algal bloom in the Lake Rotorua could result in losses to tourism (e.g. fewer visitors to Rotorua, or those visitors staying for shorter duration), which would reduce jobs in the district.

92. The studies of farming in the catchment reveal that the distribution of impacts will be uneven, and could be seen as a continuum. At one end, some farmers will already be at their 2032 targets and may have additional NDA to sell. At the other end, some farmers will be considering land use change, or selling their farm. Where this is the case there is likely to be a need for social support.

93. The process of change and reorienting of farming systems to nitrogen management is likely to require a refocus of farming skillsets, and therefore to increase farmer and

farm worker interest and participation in rural extension activities. Low nutrient practices will be important for farm viability.[16]

Conclusion

94. In conclusion, I consider that the Regional Council has addressed the key economic issues appropriately, and to the extent that it could reasonably be expected to. The research that has informed the proposed Plan Change 10 has been of a high standard and consistent with good practice.

Appendices

Appendix 1: Project Plan: Economic Impacts of Rotorua nitrogen reduction
Appendix 2: Map of Lake Rotorua catchment

Name: Sandra Alison Barns
Date: 17 January 2017

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Appendix 1: Project Plan: Economic Impacts of Rotorua nitrogen reduction

<table>
<tr><td colspan="2">Bay of Plenty REGIONAL COUNCIL</td><td>Project Plan: Economic Impacts of Rotorua N reduction</td></tr>
<tr><td colspan="2">Prepared by</td><td>15 December 2014
File ref:</td></tr>
<tr><td>Summary</td><td colspan="2">The costs of different approaches to reducing nitrogen losses in the Rotorua catchment will be assessed in terms of:
• Relative impacts of different allocation options
• On-farm impacts on profit and revenue
• District impacts on GDP, growth and employment.</td></tr>
<tr><td>Background</td><td colspan="2">The proposed Regional Policy Statement (RPS) has set a nitrogen limit for Lake Rotorua of 435 tN/y. To achieve this, the estimated total reduction is 320 tN/y with about 270 tN/y expected from the rural/pastoral sector. Of this 270 tN/y, the current framework proposes that 140 tonnes of N reduction is allocated to farmers.

Six allocation options for how this reduction is distributed are to be analysed. The options under consideration are:
1. Flat rate sector averages of 35kg/ha/yr for dairy and 13/kg/ha/yr for drystock
2. Sector averages adjusted for the influence of rainfall and soil type (i.e. with higher leaching allowances for leakier soils and higher rainfall, but with the same sector averages as for 1).
3. A flat percentage clawback from “Rule 11” nitrogen benchmarks, with final allowances fixed within the ranges of 30-40kg/ha/yr for dairy farming and 10-20kg/ha/yr for drystock.
4. A flat percentage clawback from “Rule 11” nitrogen benchmarks, with final allowances fixed within the range of 10-40kg/ha/yr for all farms.
5. A natural capital approach based on LUC classes (Land Use Capability Survey Handbook Version 3.0) where more allocation is provided to the better land classes (I, II, III….) and less to the less elite land classes (…..VI, VII VIII)
6. Equal allocation on a kgN/ha basis with a split between pastoral and very steep land.
It is likely that individual farm benchmarks will be tradable in order to increase the flexibility of the regulation and reduce overall cost.</td></tr>
<tr><td>Objective</td><td colspan="2">To assess the impacts of the different allocation options under consideration. This will include:
• Total economic impact across the catchment
• Economic impacts on different farm system types
• Likely land use across the catchment once rules are imposed</td></tr>
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<table>
<tr><td></td><td>

- Likely farm management scenarios once rules are imposed

Given that trading is proposed, it will be important to assess the impact of different levels of trading inefficiency (for example if 15% or 30% of allowances are retained despite the opportunity for advantageous transactions).
</td></tr>
<tr><td>Outputs</td><td>

First, a catchment model will need to be developed in order to determine the impacts on farm profitability and the impact of trading on the total economic cost. This involves four key steps.

1. Develop representative pastoral farm system types:
    - Use rainfall and soil maps to inform discussions with local agricultural consultants and other people and establish distinct zones that we may distinguish as being relatively similar for modelling purposes.
    - Construct hypothetical representative farms (drystock and dairy) for each zone. This may consist of multiple types of one enterprise for each zone, if one type of agriculture is particularly dominant or disparate in that zone. Expert judgement will be tested against other data (for example, the Beef & Lamb and DairyNZ economic surveys and prior studies in the catchment).

2. Establish a modelling protocol for pastoral farming:
    - Ask local consultants to establish a modelling protocol, alongside key DairyNZ staff (Alvaro Romera and Pierre Beukes), that they will utilise to prioritise mitigation actions when they decide how the hypothetical producers will respond to required reductions in N leaching.
    - Get this modelling protocol peer-reviewed and agreed by key stakeholders.

3. Determine relationships between profit and leaching:
    - Use local consultants to utilise the modelling protocol in OVERSEER and FARMAX to identify cost and leaching implications of the different mitigation scenarios for each representative farm system type. This will provide a set of relationships between profit and leaching.
    - Work with Scion to access data for forestry profitability. This will include all forestry species and management regimes appropriate for Rotorua.

4. A DairyNZ contractor will use the outputs of pastoral farming modelling (step 3 above), available data on forestry economics and BOPRC catchment data to develop a Rotorua Catchment bio-economic model. This model will then be used to test the six allocation approaches outlined above in the Background.

    These six allocation approaches will be examined under four potential policy scenarios:

    - Mitigation at farm level, with no potential for trading of nitrogen discharge allowances
    - Trading with no transactions costs
    - Trading with 15% of allowances retained (i.e. 15% of potentially advantageous transactions do not take place)
    - Trading with 30% of allowances retained
</td></tr>
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<tr><td></td><td colspan="2">Second, a report will be developed for farm-level impacts based on this catchment modelling analysis showing:
• Total economic impact across the catchment (in terms of profit and revenue)
• Economic impacts on different farm system type
• Likely land use across the catchment once new rules are imposed
• Likely farm management scenarios once new rules are imposed

Third, aspects outside the catchment model will be assessed:
• Implications of changes in profit for debt servicing
• Likely changes in farm equity
• Implications for lifestyle blocks
• Other scenarios such as Transferable Development Rights, milking sheep and mānuka, depending on data availability.

Fourth, the on-farm catchment impacts will then be used to drive district-level analysis showing the economic impacts on employment, revenue and opportunity costs (etc.).</td></tr>
<tr><td>Scope Includes</td><td colspan="2">• On-farm impacts for land in the Rotorua catchment.
• Off-farm impacts on GDP and employment.</td></tr>
<tr><td>Scope Excludes</td><td colspan="2">• Lake modelling
• Cultural impact assessment
• Social impact assessment</td></tr>
<tr><td rowspan="5">Risks and mitigation</td><td>Risk</td><td>Mitigation</td></tr>
<tr><td>Timeframe too tight</td><td>Ensure adequate resourcing from outset, maximise use of existing datasets and knowledge, develop some parts of project in tandem, ensure brief but frequent communication between all parties.</td></tr>
<tr><td>Lack of farmer cooperation</td><td>Collective members are positive about this project and the Committee and Coordinator will liaise directly with individual farmers to manage concerns as they arise. Results will be presented on a per hectare basis to maintain anonymity.</td></tr>
<tr><td>Incorrect mitigation levels and/or costs</td><td>Industry standard software, assumptions and data will be used by local agronomic experts</td></tr>
<tr><td>Inadequate resourcing</td><td>Maintain clear project management oversight with reporting to identify pending workflow. Identify industry funding and maximise use of existing work.</td></tr>
<tr><td>Success criteria</td><td colspan="2">• The relationship between N limits and profit and capital value is understood for a range of Rotorua farm systems
• The distributional impacts of different allocation options are understood for a range of Rotorua farm systems</td></tr>
</table>

	• The total economic costs are understood for different allocation options • Farmers have good information to engage with allocation options • BOPRC has good information on which to base its decisions • Public understand potential impacts of options consulted on • Final report delivered to BoPRC on time • Improved engagement between farmers and BoPRC

Milestones	Stage	What	Who	When (2014-15)
1	Set up	Agree scope and distribution of costs.	STAG Subcom.	July
2	Catchment model 1	Establish rainfall and soil zones	Alastair BoPRC	July
3	Catchment model 1	Establish representative farm system types.	BOPRC contractor A/ Alvaro/Graeme/ B&L expert	Mid-August
4	Catchment model 2	Develop modelling protocol.	BOPRC contractor A/ Alvaro/Graeme/ B&L expert/ farmers	End of August
5	Catchment model 3	Develop scion forestry data	Scion	7 November
6	Catchment model 3	Model profit/leaching relationships	BOPRC contractor B	10 November
7	Catchment model 4	Build optimisation model using data from 2-4.	Alvaro DairyNZ	Dec/Jan
8	Draft on-farm report	Use catchment model to write report on on-farm impacts. First draft delivered for feedback and review.	Alvaro/ Graeme Doole	February
9	Peer review	Stakeholders peer review report and agree content	All	March
10	Report back to STAG	Report catchment modelling results to STAG to support comparison of allocation options.		April

11	Draft district impact report	Use on-farm catchment analysis to support district impacts report (e.g. input-output or CGE).	BOPRC contractor C	March/April
12	Report back to STAG	Report back on full district economic analysis	BOPRC contractor C	May
13	Final reports	Incorporate peer review feedback and finalise reports for s.32	BOPRC contractor C/ BOPRC	June
Project Team and Coordination	The project manager is The project sponsor is Not charged: Charged:			
Project Linkages	• Reference and leverage off data and findings from three local SFF projects: Lake Rotorua Collective; Lake Okaro; and Project Rerewhakaaitu • The RPS, 10 Year Plan, Regional Water and Land Plan and Rotorua District Plan • Rotorua-Rotoiti Action Plan and more recent STAG direction on nitrogen allocation			

Appendix 2: Map of Lake Rotorua catchment