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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SUMMARY OF EVIDENCE IN CHIEF OF ALASTAIR CHARLES MACCORMICK ON BEHALF OF THE BAY OF PLENTY REGIONAL COUNCIL

Evidence topic: OVERSEER® and Proposed Plan Change 10; the Use of Reference Files.

Contents:

1. Qualifications and Experience

2. Scope of Evidence and Summary

3. Plan Change 10 Allocation Methodology

Benchmarking

OVERSEER® updates

Nitrogen allocation calculations

Calculating reduction targets and block allocations

Managing OVERSEER® version changes using reference files

Maintaining allocation integrity with time

4. Responses to Submissions

Review of reference file performance

Updating the allocation to OVERSEER® 6.2.3

5. Conclusion

Qualifications and Experience

1. My full name is **Alastair Charles MacCormick**. I am employed by Bay of Plenty Regional Council as a Senior Lakes Technical Officer, a position I have held at various levels for 10 years.

2. My background, experience and qualifications are set out in the full version of my evidence in chief, which I confirm but do not repeat in this summary. Likewise I confirm my compliance with the Expert Witness code of conduct as set out in full there.

3. My position has focused on providing advice and data analysis to the council planners during the development of PC10. In this role I have contributed to Stakeholder Advisory Group (StAG[1]) and I have also provided benchmarking information to consultants and scientists for the purpose of analysis. In conjunction with Dr Kit Rutherford I developed the catchment discharge coefficients for use in the 2016 ROTAN update (ROTAN-Annual). This is explained in Dr Rutherford's evidence ("Rutherford 2016").

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

Scope of Evidence and Summary

5. My evidence covers the technical aspects of the PC10 allocation methodology. It explains how the base allocations were developed then describes how those allocations are reduced to achieve the catchment targets. It then goes on to explain how the allocations are adjusted with OVERSEER® version changes. Throughout I provide my opinion on the technical robustness of the use of OVERSEER® in PC10, concluding that it provides a technically robust approach that responds to the dual needs of certainty and flexibility. In response to submissions, I review both the reference file performance and a revised 6.2.3 based allocation system. I conclude that the new reference file methodology set out in the evidence of Mr Matheson (Matheson 2017), is preferable to the earlier version; and that the proposed 6.2.3

[1] See evidence of Mr Lamb explaining StAG.

allocation system is not preferable. My reasons for this are summarised in the evidence[2] below.

PC10 Allocation Methodology

Benchmarking (EIC paragraphs 10-16)

6. Nutrient benchmarking is a requirement from the series of rules (commonly termed "rule 11") in the Regional Water and Land Plan. The intention of benchmarking was to cap nitrogen and phosphorous discharges and to stop further intensification in the catchments of five of the Rotorua Lakes[3]. A property's benchmark forms the basis from which its PC 10 allocation is derived. The key aspects of the benchmarking process are:

   (a) It is a nitrogen and phosphorus loss prediction for the 2001-2004 period using the OVERSEER® model;

   (b) The majority of the catchment has been benchmarked but many smaller properties have not (Figure 1);

   (c) The benchmarks were developed as thoroughly as available data allowed therefore represent a "best estimate";

   (d) The benchmarks have been updated into OVERSEER® 6.2.0 and subsequent versions. However, in some instances this has required additional data, and changes to files.

   (e) Some dairy farms have not provided their benchmarking OVERSEER® files therefore their benchmarks weren't able to be updated into OVERSEER® 6.2.0 or later versions.

[2] It should be read with the evidence on the use of OVERSEER® and reference files in the evidence of Mr Park (Park 2017) and the overall explanation about the approach to nitrogen management provided in the evidence of Mr Lamb (Lamb 2017).

[3] See the evidence of Lamb.

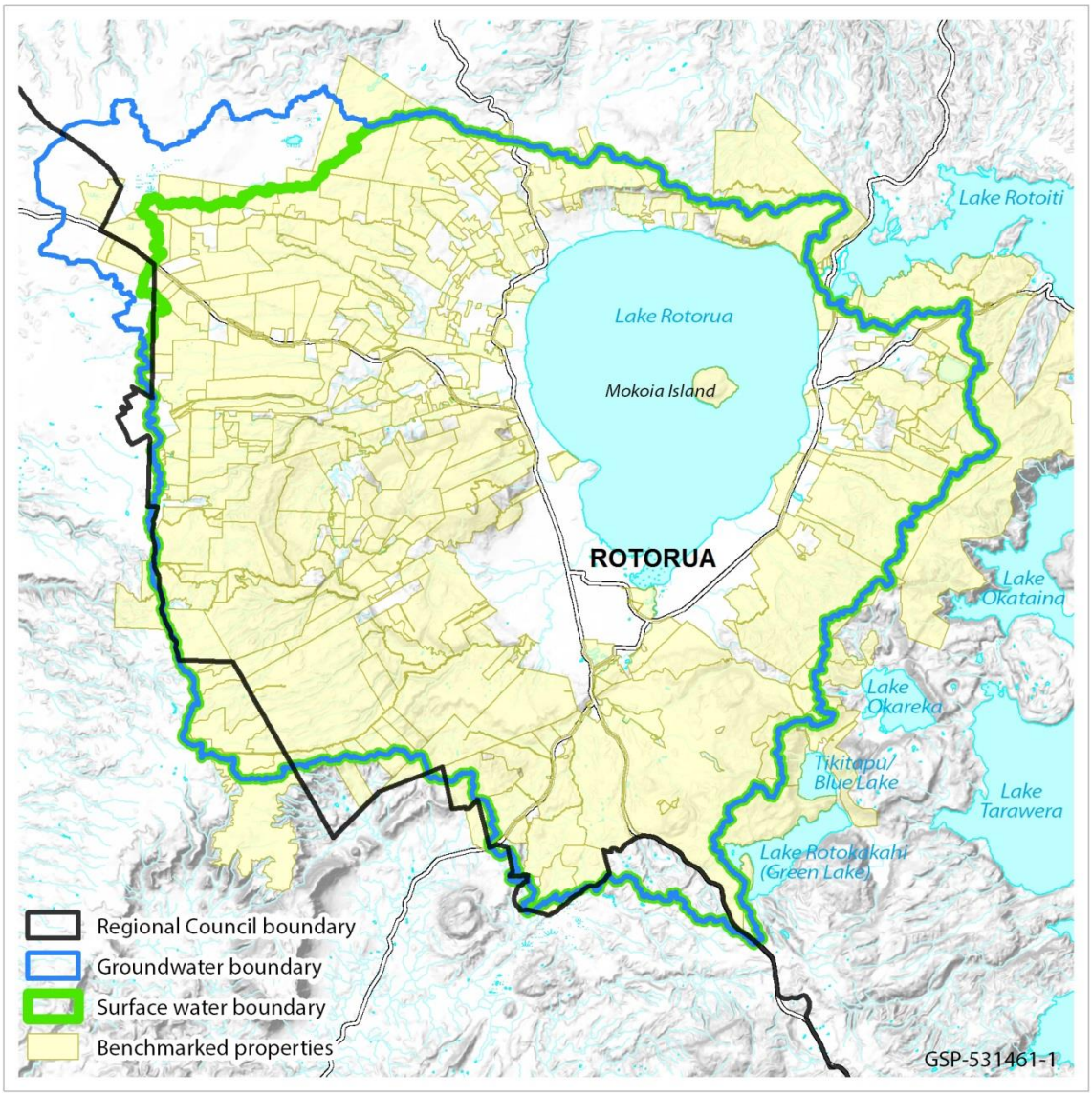

Figure 1. Benchmarked properties within the Lake Rotorua groundwater boundary.

OVERSEER® updates (paragraphs 17-20, 35)

7. OVERSEER® typically updates twice per year to reflect new science, incorporate new features and resolve bugs within the model. Since benchmarking, this has resulted in:

   (a) the continual improvement in how well OVERSEER® models Rotorua farm systems;

   (b) a significant increase in predicted losses from the 2001-2004 benchmarked farm systems;

8. The predicted N losses from a specified farm system vary with different versions of OVERSEER®. Therefore, both the farm allocation and performance need to be predicted in the same version before they can be compared.

9. The reference file method in combination with five year NMPs is designed to provide periods where the farmer is 'shielded' from the effects of frequent version changes whilst also allowing for the periodic incorporation of new science within OVERSEER®.

PC10 nitrogen allocations (EIC paragraphs 21- 27)

10. Nitrogen has been provisionally allocated to all rural land in the catchment based on the benchmarked OVERSEER® 6.2.0 discharges and the 2001-2004 land use. Under PC10 land uses are grouped into six categories/sectors; drystock, dairy, bush and scrub, plantation forestry, grazed trees, and house. Non-benchmarked land has been categorised into the same categories based on the 2002/2003 aerial photography.

11. All rural land within the catchment was then assigned an OVERSEER® 6.2.0 nitrogen discharge as follows:

    (a) Benchmarked land where we hold the OVERSEER® file was assigned the OVERSEER® 6.2.0 discharge.

    (b) Benchmarked land where we don't hold the benchmark file was assigned an estimated 6.2.0 discharge based on multiplying the 5.4.11 block discharge by the average OVERSEER® shift for that land use.

    (c) Non benchmarked land received the average discharge for the relevant land use sector.

12. The result of the above process is that all rural land in the catchment is divided into spatially defined blocks. Each block is assigned a PC10 land use sector and either has an actual OVERSEER® 6.2.0 discharge or a derived 6.2.0 discharge.

13. Schedule LR One gives scope for derived benchmarks to be amended where there is evidence of substantial change or where the property was not previously managed by Rule 11.

Calculating the reduction targets and block allocations (EIC paragraphs 28 - 34)

14. The allocation methodology is structured to achieve proportionally the same level of total sector nitrogen loss reduction as proposed in the Integrated Framework[4] i.e. a 35.3% reduction from dairy and a 17.2% reduction from drystock.

15. Each block's 2032 pNDA is calculated based on its sector, its benchmarked 6.2.0 nitrogen discharge and the standard sector percentage reduction and ranges. The ranges consist of an upper and lower limit for each sector and the standard sector percentage reduction is the reduction applicable to a block with a near average OVERSEER® 6.2.0 nitrogen allocation.

Table 1. Standard sector reductions and range bounds for each sector.

	Dairy	Drystock
Standard sector percentage reduction (%)	31.3	20
Lower nitrogen discharge allowance range boundary (kg N/ha/yr)	54.6	18
Upper nitrogen discharge allowance range boundary (kg N/ha/yr)	72.8	54.6

16. In words, the equations to calculate the block provisional Nitrogen Discharge Allowance (pNDA) are as follows:

    (a) If the block OVERSEER® 6.2.0 per hectare nitrogen discharge is reduced by the standard sector percentage reduction and the result is more than the upper limit, then the block allocation shall be reduced to the upper limit;

    (b) If the block OVERSEER® 6.2.0 per hectare nitrogen discharge is reduced by the standard sector percentage reduction and the result is between the upper and lower limits, then the block allocation is the result;

    (c) If the block OVERSEER® 6.2.0 per hectare nitrogen discharge is reduced by the standard sector percentage reduction and the result is less than the lower limit, then the block allocation is the lower limit.

    These equations ensure no block is allocated a pNDA less than the sector lower limit or more than the sector upper limit.

17. The standard sector percentage reduction differs from the total sector contributions in the integrated framework because the N removed above the upper bound does not equal the N added below the lower bound. For the dairy sector more N is removed

[4] Explained in the evidence of Lamb, 2017.

than added so the standard sector reduction (31.3%) can be less than the total sector contribution (35.3%). For the drystock sector more N is added than removed so the standard sector reduction (20%) needs to be more than the total sector contribution (17.2%).

Managing OVERSEER® version change using reference files (EIC paragraghs 35 - 43)

18. The 'reference file' method in PC10's Schedule 5 is designed to manage OVERSEER® version updates.

19. There are five reference files: drystock; dairy; plantation forestry; native bush/scrub; house block. Losses from grazed trees are referenced against the drystock reference file.

20. The drystock and dairy reference files (as notified) are 100 ha hypothetical farm systems that proportionally represent the biophysical characteristics of the benchmarking files and are realistic and economically viable. Their discharge closely approximates the 2032 average sector load.

21. Each block's start point and 2032 pNDA is defined using the ranges and methods described above. For each sector the block pNDA's are then compared to the reference file output in order to determine the block allocation as a percentage of the reference file. For each block four percentages are determined; Start point, 2022 Managed Reduction Target (MRT), 2027 MRT and the 2032 pNDA. The percentage values remain fixed over time i.e. the percentages do not change as OVERSEER® is updated.

22. As new OVERSEER® versions are released, the five reference files are re-run using the latest version. The revised reference file loss rates are then multiplied by the start point, MRTs and pNDA for each block in order to calculate revised block allocations that are relevant to the latest version of OVERSEER®. An existing or new farm map can now be superimposed over this revised GIS allocation layer to calculate a property total pNDA.

23. Because individual farms are not exactly the same as the reference file farm systems, it is unlikely that the degree of change in predicted N losses resulting from a version update will be exactly the same as the change in the reference files. These

differences in relative nitrogen loss shifts are unavoidable within the reference file system as it is designed in PC10.

Maintaining the allocation integrity with time (EIC paragraph 44)

24. Maintaining the integrity of the allocation system over time is essential to protecting individual rights to discharge and achieving the water quality targets. Listed below are five aspects of the proposed rules that achieve this:

    (a) Fixing the allocation to a single version of OVERSEER®.

    (b) Maintaining "like with like" comparisons through the use of reference files and standardised biophysical data.

    (c) Maintaining a spatially fixed allocation map that is independent of property boundaries or ownership.

    (d) Standardising how OVERSEER® is used.

    (e) Five year science reviews described in Method 2 (LR M2).

Responses to Submissions

Review of reference file performance (EIC paragraphs 45 - 58)

25. Several submissions were received recommending that the reference files should be more representative of current farm systems. (See section 42A report).

26. To test the reference file performance, the reference file total N loss in versions 6.2.0, 6.2.1, 6.2.2 and 6.2.3 was compared on a percentage basis against the average sector benchmark. This comparison showed that the drystock reference file tracked the benchmarks reasonably closely whereas the dairy reference files did not. Comparison of a typical current dairy system reference file showed a similar divergence when compared to the average dairy benchmark.

27. A meeting was held with submitters to discuss this issue. The consensus view of submitters was that the reference files should track the benchmarks as closely as possible (see also Park 2017).

28. Further investigations revealed that the divergence from the benchmark average resulted from differences in how effluent was entered between the reference file and the benchmarking files.

29. To find a solution three approaches were investigated; altering the existing reference files, altering the newly developed "current" dairy reference file and developing a revised set of dairy and drystock reference files that reflect the benchmark files in terms of the input data, the file structure and the N discharge.

30. Overall the revised reference files demonstrated the closest alignment with the average benchmark discharges.

Updating the allocation to OVERSEER® 6.2.3 (EIC paragraphs 59 – 72)

31. Submissions have sought that the nitrogen allocation be anchored in a more recent version of OVERSEER® than 6.2.0 (as notified).

32. To test the effect of this option, a 6.2.3 based allocation was developed using the Schedule One methodology and a revised upper bound, lower bound and standard sector reduction based on the average sector shift of the benchmark files from version 6.2.0 to 6.2.3. Any changes to the benchmarking data since the 6.2.0 based allocation were included.

33. This 6.2.3 based allocation was then compared to the current allocation in 6.2.3 equivalents (i.e. using existing 6.2.0 percentage allocations multiplied by the reference file output in 6.2.3) using:

    (a) The reference files as notified however, to enable a meaningful comparison the existing dairy reference file has been substituted for the related file modified to include 100% effluent blocks.

    (b) The revised reference files based on average benchmarking data.

34. Both approaches resulted in increases to the average property allocations and an erosion in the catchment reductions achieved. The largest individual property changes

generally resulted from increases in discharges from grazed tree blocks and cropping blocks. Under both scenarios more than 60% of properties would have their allocations changed.

Conclusion (EIC paragraphs 73-75)

35. In my opinion the reference file methodology provides the best method to manage the allocations in the Rotorua catchment given the proposed rule structure. The basis for my opinion is:

    (a) "Bugs" are as likely to occur in individual farm allocation files as they are in the reference files.

    (b) Because there are only five reference files, Council's ability to identify and manage "bugs" is better than if there were hundreds of individual OVERSEER® files defining allocations in the catchment.

    (c) Allocations are likely to fluctuate less under the reference file methodology as allocations are anchored in a single version.

36. With regard to the reference files used to define allocations I recommend that the revised reference files described in the Perrin Ag Consultants Ltd, (2016) report 'Methodology for and output from further revision of NDA reference files, December 2016" are adopted. The basis for my opinion is:

    (a) The underpinning principle behind the proposed rules is that farm allocations are reduced from benchmark levels to a lower level and that the revised reference files are most likely to track the sector benchmark averages in the future.

    (b) Of the options assessed these reference files have tracked the average benchmarks with the closest alignment.

    (c) The structure of these files is most likely to result in any bugs being common between the reference file and the farm performance file thereby maintaining "like with like" comparisons. This is in contrast to the current reference file strategy that aims to avoid "bugs" through the use of a simple farm system.

37. I recommend maintaining the current 6.2.0 based allocation for the following reasons:

(a) A 6.2.3 allocation results in a reduction in the amount of nitrogen being removed from the catchment (about another 6 tN would have to be removed through some other method).

(b) For farmer decision making certainty, allocation needs to be fixed to a single version rather than being constantly re-evaluated which will invariably benefit some and disadvantage others. The notified allocation ranges and standard reductions were tested through the StAG community forum. Ideally if a new allocation version were to be adopted, the ranges and resulting allocations would be tested in the same manner.

(c) Provisional NDAs have been provided to many landowners in order to help them understand the significance of PC10 on their farm enterprise. Changing those will likely result in disruption and confusion with minimal benefit.

(d) The majority of increases in allocations largely occur on very low intensity blocks. This change appears to have occurred between versions 6.2.1 and 6.2.2. I am uncertain whether this is an intended change in nitrogen leaching predictions and have logged a job with OVERSEER® requesting it be investigated. If this change is reversed it is likely that the overall relative change in allocations will be minor, however there would still be shifts in allocations between properties.

Name: Alastair Charles MacCormick
Date: 3 March 2017