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 SIMON CHRISTOPHER PARK
ON BEHALF OF THE BAY OF PLENTY REGIONAL COUNCIL

Evidence topic: The use of OVERSEER® and reference files

Contents:

Qualifications and experience

1. My full name is **SIMON CHRISTOPHER PARK** and I am a director of Landconnect Ltd (formerly 'Headway Ltd'). I am contracted by Bay of Plenty Regional Council to provide advice on nutrient management issues within the Rotorua Te Arawa Lakes Programme. This is a contract that I have held in various permutations since 2006.

2. Prior to establishing my environmental consultancy business in 2006, I was employed by: Tauranga City Council (2004-2006) as a senior consents officer; Ministry for the Environment as a policy analyst on land and water issues, notably Lake Taupo nitrogen management and the 'Dairying and Clean Streams Accord (1999-2003); Bay of Plenty Regional Council as a resource consent officer (1996-1999).

3. I have the following qualification: M.Sc. (1st Class Hons) in Earth Sciences from Waikato University, with a soils-focused thesis on nitrate leaching from dairy cow urine patches. I also have a Certificate in Advanced Sustainable Nutrient Management (Massey University, 2009) and recently qualified as a Resource Management Act Commissioner (Making Good Decisions course, 2016).

4. I have the following professional memberships: New Zealand Association of Resource Management; New Zealand Soil Science Society; New Zealand Grassland Association.

5. **My field of expertise is the application of nutrient management knowledge within a RMA planning framework.** This is reflected in a series of conference papers I prepared for Massey University's annual Fertiliser and Lime Research Centre workshop: Practical and regulatory factors in nutrient benchmarking with OVERSEER – a Rotorua Lakes perspective (Park and A MacCormick, 2009); Rotorua benchmarking: challenges and progress (Park and P MacCormick, 2011); Solutions for a sustainable Lake Rotorua: the farmers' perspective (Kingi et al, 2012); Nitrogen losses from Lake Rotorua dairy farms - modelling, measuring and engagement (Park et al, 2014); The context and practice of nutrient mitigation on Rotorua dairy farms (Park et al, 2015); Considering small blocks in catchment nitrogen allocation (Park at el, 2016).

6. I do not consider that I have any conflicts of interest regarding my statement of evidence. However, I do have or have had professional working relationships with several submitters and related entities. In the interests of transparency, I note these

relationships in Appendix B of my evidence. My work for the Bay of Plenty Regional Council has been as an independent contractor. I continue to accept technical contracts with various groups.

7. As a contractor to the Regional Council, I have worked in several roles within the Rotorua Te Arawa Lakes Programme in preparation for PC 10, as follows:

   (a) I had a support role for the Lake Rotorua Primary Producers Collective from 2012 to October 2015, as noted in Appendix B.

   (b) I was Secretariat to the Stakeholder Advisory Group (StAG) from 2012 to December 2015. I prepared agendas, minutes, liaised with StAG members and BOPRC staff, gave several technical presentations and prepared regular StAG update reports to the Rotorua Te Arawa Lakes Strategy Group. In a related post-StAG initiative, I convened a working group and drafted the Memorandum of Understanding drafted and edited.

   (c) I gave policy and technical advice on the use of the OVERSEER® nutrient budget model (hereafter, referred to as 'OVERSEER') related to 'Rule 11' (Operative Water and Land Plan) and new draft/proposed rules. This advice extended to nitrogen allocation options and OVERSEER version management with presentations given to StAG, staff and Council.

   (d) In related work for Council, I assisted the collaborative OVERSEER Guidance Project Board (comprising regional councils, Government and industry bodies) by writing the overall business case and drafting project briefs for the three main project outputs: (i) Technical Description of OVERSEER for Regional Councils (Watkins and Selbie, 2015); (ii) Stocktake of Regional Council Uses of OVERSEER® (Arbuckle, 2015), and; (iii) Using OVERSEER® in Regulation – technical resources and guidance for the appropriate and consistent use of OVERSEER® by regional councils, August 2016 (Freeman et al, 2016).

   (e) I assisted Mr Andy Bruere at BOPRC by supporting the Land Technical Advisory Group from 2014 to 2015, including preparing the group's Terms of Reference, agendas, minutes and several technical presentations related to OVERSEER and the Rotorua dairy SFF project.

   (f) I provided input to several reports that influenced PC 10 development, including writing project briefs, liaising with lead contractors and peer review of drafts, including the following: (i) Farmer Solutions Project (Perrin Ag

Consultants, 2012); (ii) Rotorua NDA Impact Analysis (Perrin Ag Consultants, 2014); (iii) On-farm effects of diverse allocation mechanisms in the Lake Rotorua catchment (Parsons et al, 2015).

(g) I undertook drafting on PC10 Schedule Five on the use of reference files and contributing more generally to editing draft versions of PC10.

8. I have been involved with farmers and farm nutrient losses in the Lake Rotorua catchment for almost 10 years. I have had the benefit of working with local farmers, agricultural advisors, scientists and Council staff over this time. I am therefore familiar with farm nutrient loss issues in the Lake Rotorua catchment, particularly in relation to the use of OVERSEER within PC10.

9. 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.

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

Scope of Evidence and Summary

11. I prepared a report entitled 'Using Overseer within Rules for the Lake Rotorua Catchment' dated 2014. A copy of that report was uploaded to the Rotorua Te Arawa Lakes Programme website and forms part of the information on a web page headed 'Calculating nitrogen loss'. The report was also referenced in the section 32 report produced by the Regional Council in support of Plan Change 10.

12. In collaboration with staff from Bay of Plenty Regional Council, I wrote 'Schedule LR Five – Use of OVERSEER® and Reference Files' in Plan Change 10. This Schedule describes the 'reference file method' which manages the consequences of OVERSEER version updates on a property's N loss limits.

13. My evidence is based upon my 2014 OVERSEER report, Schedule Five of Plan Change 10, several other reports that I refer to and my professional assessment of what is technically necessary to effectively manage nutrient losses from rural land in the Lake Rotorua catchment. I also provided input in response to issues raised in submissions relating to OVERSEER, Schedule Five and options to improve the

reference file method. This part of my evidence is referred to in the section 42A report and resulting recommendations of staff.

14. My opinion and conclusions in the 2014 report addressed the practical and theoretical issues about using the OVERSEER nutrient model as part of a regulatory approach to the reduction of nitrogen losses from rural land uses in the Rotorua catchment. The 11 recommendations from my 2014 report are repeated in Appendix C of my evidence for ease of reference. For the most part I am still of the same opinion, except where I explain otherwise.

15. **In summary, I make the following conclusions and recommendations in respect of the use of OVERSEER and reference files in Plan Change 10:**

    (a) OVERSEER is used appropriately in PC10: (i) to help quantify allowable nitrogen loss at the property level, and; (ii) within rules that require compliance with those property nitrogen limits. This appropriate regulatory use of OVERSEER is based on both the robustness of the model and the methods adopted within PC10 to address the model's inherent limitations. (My detailed reasons are given in paragraphs 17 to 49.) Given this, it is my opinion that it is appropriate to retain **the notified PC10 provisions related to OVERSEER. However, I do recommend some modification to the reference file method as noted in paragraph 15(b) below.**

    (b) The reference file method in LR Schedule 5 is intended to address the ongoing biannual version updating of OVERSEER which can result in changes to OVERSEER outputs, generally reflecting improved science. Since notification, some issues with the dairy reference file method were identified by Council staff, discussed with several submitters (15 September 2016), and a revised and improved reference file method developed by Mr MacCormick (Council) and Mr Matheson (Perrin Ag 2016a). **In my opinion the revised reference file method is an improvement on the notified version and I therefore recommend that it be adopted in place of the notified version.** My detailed reasons are given in paragraphs 50 to 55 of my evidence (see also Mr MacCormick's EIC).

Background materials and reports referenced

16. While preparing this evidence, I have had regard to the following documents:

    (a) Council's section 32 report, 42A report and submissions about OVERSEER.

(b) Documents listed in the References section of this evidence.

(c) The evidence of Ms Burton, Mr Lamb, Mr MacCormick and Mr Matheson.

Evidence on the use of OVERSEER and reference files

17. OVERSEER was first developed over 20 years ago as a decision support tool to aid fertiliser decisions on New Zealand pastoral farms. Over time, OVERSEER has evolved to cover a wide range of land uses and to estimate nutrient losses from farms.

18. Since the mid-2000s, several regional councils found OVERSEER a useful tool to help manage diffuse nutrients within a regulatory framework. This growing regulatory use is described by Arbuckle (2015). As with all models, OVERSEER approximates reality (Freeman et al, 2016). However, OVERSEER is the most pragmatic and widely used tool to assess nitrogen (N) and phosphorus (P) loss from farms in New Zealand.

19. The technical basis of the model is explained in AgResearch's plain English Technical Description (Watkins and Selbie, 2015). In the PC10 context, OVERSEER estimates the N loss rate from properties in both a predictive mode (using assumed future inputs) and a monitoring mode (using actual farm inputs). PC10 uses OVERSEER:

(a) to inform catchment N load modelling with different N loss rates tailored to a range of historical and current land uses i.e. ROTAN (see Dr Rutherford's EIC)

(b) to inform N allocation between and within major land uses i.e. the Integrated Framework (see Mr Lamb's EIC)

(c) to provide information to help set property N limits i.e. 2017 N start points (2022 for certain properties) and subsequent Managed Reduction Targets for 2022, 2027 and 2032, with the latter being the 2032 NDA (see Mr MacCormick's EIC)

(d) as part of Nitrogen Management Plans[1] (NMPs) (see Mr Lamb's EIC).

20. The regional planning uses of OVERSEER are covered in Freeman et al. (2016) by identifying ways that OVERSEER can be used effectively in regulation and methods to manage OVERSEER's limitations. In my opinion, PC10 is wholly consistent with the Freeman et al. (2016) national guidance on the appropriate use of OVERSEER in

[1] Although there are submissions that NMPs become 'Nutrient Management Plans', my evidence presumes the abbreviation is for 'Nitrogen Management Plans', as per the notified PC10.

regulation. This level of consistency is not the case for all the regional uses of OVERSEER elsewhere that I am aware of.

21. PC10's use of OVERSEER is made carefully in recognition of the model's limitations. Nevertheless, many submitters have raised concerns about OVERSEER, including:

    (a) OVERSEER was not designed for regulation and should only be used for guidance e.g. as a decision support tool

    (b) OVERSEER is not accurate and/or not calibrated for Rotorua conditions

    (c) Regular version changes make it unreliable, including:

        (i) Risk of non-compliance from version updates even though the farm system OVERSEER inputs are unchanged

        (ii) Large changes in N loss predictions during PC10 development undermine total N load and reduction predictions

    (d) Property N limits based on OVERSEER are not enforceable

    (e) Not all farm systems and/or mitigations are covered by OVERSEER

22. Submitters also raised concerns about the reference file method, stating that is was too complex, too focused on Council data management and flawed in being linked to a single OVERSEER version (6.2.0).

23. The above statement of my opinion on the continued appropriateness of the use of OVERSEER in PC10 (para 15) is made having considered these submission points.

24. I address these concerns in my evidence using the following **bolded** subheadings:

- The need for quantitative assessment of N losses
- OVERSEER's use as a decision support tool
- Using the most recent version of OVERSEER
- PC10 reference to OVERSEER version 5.4 values
- Managing uncertainty in OVERSEER
- Local calibration of OVERSEER
- Use of data input standards and protocols to reduce variability
- Enforceability of OVERSEER N limits
- Alternatives to using OVERSEER

- Managing OVERSEER version changes with the reference file method.

The need for quantitative assessment of N losses

25. If it was feasible to take a robust qualitative approach to managing N loss reductions in the Lake Rotorua catchment, then the use of a quantitative tool like OVERSEER may not be necessary. I consider that a quantitative tool approach is needed because:

    (a) To achieve the Regional Policy Statement (RPS) sustainable annual nitrogen load of 435 tonnes (Policy WL 3B(c)), the aggregate reduction needed from rural land is approximately 46%[2]. This is explicitly a quantitative reduction target and implicitly requires a tool capable of quantifying N reductions from rural land.

    (b) The RPS anticipates the use of rules to achieve this reduction in N load, with Policy WL 6B stating 'Require, including by the use of rules, the managed reduction of any nutrient losses that are in excess of the limits established under Policy WL 3B…' RMA rules are generally applied and enforced at the property level which, in combination with the quantitative catchment N target, implies rules that incorporate quantitative property N limits.

    (c) Most land in the Lake Rotorua groundwater catchment already has a property-based and OVERSEER-derived quantitative nutrient benchmark (N and P) under the operative 'Rule 11' of the Regional Water and Land Plan.

    (d) The N allocation method adopted in PC10 relies largely on the Rule 11 benchmarks to determine the starting place for allocation limits (see s42A report by Ms Burton and Mr Lamb's EIC para 85 onwards for more detail).

26. The quantitative assessment of N losses from individual properties relates directly to the property's N limits for 2017, 2022, 2027 and 2032. These property-scale N assessments (based on OVERSEER) are used in two key ways:

    (a) In future predictive scenarios i.e. determining what set of on-farm actions to include in a property's NMP that can, in combination, meet future N limits;

[2] The ROTAN in-lake steady state 'rural' N load is 526 tN/yr out of a total load of 755 tN/y (NIWA 2011). The reduction envisaged by the Integrated Framework is 240 tN, including rules and incentives but excluding the gorse scheme. 240/526 = 45.6%. 'Rural' means all non-forested rural land uses i.e. mainly drystock and dairy uses, plus minor contributions from lifestyle, cropping and horticulture.

(b) In compliance i.e. retrospectively using actual property/farm inputs to determine actual N loss for the past year (or other previous years) and check against the relevant N limit and NMP[3].

27. Several other regional councils have successfully incorporated OVERSEER into their regional plan regulations, albeit using a variety of methods. These methods are canvassed in a 2015 'Stocktake' report (Arbuckle, 2015). Arbuckle also notes that the regulatory use of OVERSEER has been unsuccessfully challenged at council Hearings, the Environment Court and the High Court. The use of OVERSEER and an updating reference method has also been approved in a recent decision of Environment Canterbury, adopting the recommendations[4] of an independent hearings panel.

28. In summary, the PC10 policy context requires a method to assess property scale N losses in a quantitative manner, something that OVERSEER can do.

OVERSEER's use as a decision support tool

29. OVERSEER is also used for fertiliser advice, from fertiliser company representatives and independent farm advisors. In general, OVERSEER files developed for fertiliser advice are simpler, quicker to prepare and less robust than a regulatory OVERSEER file, because they have a different purpose and would not be cost-effective otherwise.

30. The differences in purpose and file types can result in differences in N loss outputs for the same farm if a regulatory file is compared with a fertiliser advice file. This matter has been discussed between BOPRC staff and senior fertiliser company staff with the following clarification given by BOPRC[5]:

(a) Fertiliser company staff and consultants completing a nutrient budget for regulatory purposes shall explain to their clients that the 'regulatory' nutrient budgets may differ from the other budgets due to the different purposes of the nutrient budgets and the data and assumptions made.

(b) BOPRC geospatial data will be made available promptly upon request to landowners' agents (fertiliser reps and consultants) to use in developing an OVERSEER file.

[3] The primary point of compliance for PC10 is the NMP – see Council's s42A for more detail.
[4] Report of the Hearing Commissioners (Plan Change 3) 7 September 2016, whereby numerical flexibility caps, maximum caps and catchment load limits are updated upon each OVERSEER version update using methods set out in Schedules 29-31.
[5] Paraphrased from BOPRC's letter sent to Ballance and Ravensdown senior staff in October 2015.

31. OVERSEER can be used both as a regulatory and decision support tool, even though the latter use was the original basis for its development. These dual uses are complimentary rather than mutually exclusive, particularly when the different purposes are explicitly recognised (as described in paragraph 30 above). This dual use approach is supported by Freeman et al. (2016).

Using the most recent version of OVERSEER

32. OVERSEER is regularly updated and each new version replaces the previous version which either becomes unavailable (OVERSEER on-line) or ceases to function (downloaded stand-alone versions of OVERSEER). The rationale for OVERSEER updates is explained in Freeman et al. (2016, section 6.2) as follows:

> "OVERSEER is usually updated twice per year, with one significant version change usually in May, and a minor one later in the year, usually in November. A version change can involve relatively minor matters such as the model user interface wording or an output report wording, improving the data entry methods, fixing an insignificant software bug, or adding some functionality that doesn't change the 'engine' calculations. These types of changes would not have any impact on nutrient loss estimates. Conversely, a version change can involve a significant new or upgraded module, such as happened in April 2015 with the introduction of the new irrigation module.
>
> A significant version change can also result from incorporation of new research information, changes resulting from reviews of model components, responses to investigations into reported anomalies, updating a model component with new data (e.g., N content of pasture species), addressing a significant software defect or bug, improving an algorithm with new information, etc. These types of changes can result in significant changes in estimates of nutrient loss.
>
> There are also important linkages with information sources such as the S-map soils database (http://smap.landcareresearch.co.nz/home) that is a recommended (BPDIS, 2016) source of soil characteristic input data for OVERSEER. Those soil characteristic inputs can affect the estimates of nutrient loss. The soil characteristics information in the S-map soils database can change as a consequence of improved information, and new S-map information used as an input into OVERSEER can result in changes in OVERSEER nutrient loss estimates.
>
> Version changes that result in changes in estimates of nutrient loss should be considered as moving towards a closer approximation of what the actual losses are likely to be i.e., reducing the uncertainty associated with nutrient loss estimates."

33. My 2014 report (Park, 2014) and Freeman et al (2016) recommend always using the most recent version of OVERSEER. PC10 (as notified) takes a hybrid approach to specifying the OVERSEER version:

    (a) The initial N allocation prescribed in LR Schedule One relies on OVERSEER version 6.2.0. The N allocation limits (start point, MRT & NDA) are subsequently adjusted using reference file method which occurs when an NMP is first determined and whenever it is updated (at least every five years).

Within each sector, the N limit adjustments will be in proportion to the shift in the sector reference file. Therefore the 'within sector' proportionality of the original allocation (in OVERSEER version 6.2.0) will be maintained. The rationale is that the proportionality of the initial N allocation is sound and should therefore be maintained into the future.

(b) The latest OVERSEER version will always be used by landowners and BOPRC to check compliance against N limits after the latter have been adjusted via the reference file method. This enables a 'like with like' comparison between a property's current OVERSEER file N output and the property's N limit.

34. There are several alternative ways to address the challenge of ongoing OVERSEER version updates. These are canvassed extensively in Freeman et al (2016) and more briefly in the PC10 s32 report. Section 10.6.2 of Council's s32 report summarised the non-reference file alternatives as follows:

(a) Ignore version changes by using a specific OVERSEER® version indefinitely, with compliance against fixed NDA levels.

(b) Use a specific OVERSEER® version for a finite period, then formally update the specified version and recalculate NDAs via a plan change process.

(c) Do not specify any version, but rely on OVERSEER®-based actions being incorporated into the Nitrogen Management Plan which is subject to compliance monitoring.

(d) Always use the latest version of OVERSEER® and allow some informal compliance flexibility against fixed NDA levels.

35. The preferred option in PC10 is to use the latest version of OVERSEER and specify a method to adjust NDAs to maintain the proportionality of individual property N limits across multiple future version changes. This adjustment method is the Schedule Five reference file method (see para 48 to 54 on of my evidence). My opinion is that the rationale provided at Section 10.6.2 of the s32 report for using the latest version of OVERSEER remains sound, subject to (i) the initial allocation being determined once using a single version (i.e. 6.2.0), and (ii) using reference files to maintain allocation proportionality across version updates. The potential problems that may arise if reference files (or a comparable version management method) are not used are addressed in paragraph 53 of my evidence.

PC10 reference to OVERSEER version 5.4 values

36. PC10 briefly refers to version 5.4 of OVERSEER in its Introduction section[6] when describing overall catchment N loads to the lake, as determined by the ROTAN model. That is because when the ROTAN model was developed and the associated report was published (NIWA, 2011), the then current version of OVERSEER was 5.4 (or subsidiary versions[7]). The balance of PC10 refers to either version 6.2.0 for initial N allocation purposes, or to the 'latest version of OVERSEER' all other purposes.

37. It is acknowledged that this approach gives potential for confusion, especially as there were large average increases in N loss since OVERSEER version 5.4. In the real world, an OVERSEER version change will not change:

    (a) Actual N leaching rates

    (b) Actual N attenuation

    (c) Actual N load to the lake

    (d) The overall % N reduction effort needed from farmers.

38. The 'Integrated Framework' essentially fixed the overall farm N reduction effort at 27% below 2001-2004 levels, and this overall reduction proportion remains constant despite OVERSEER version updates. The science implications of changes in modelled N leaching rates, including attenuation, is covered in the evidence of Mr Bruere and Dr Rutherford.

Uncertainty in OVERSEER

39. Concerns have been raised by PC10 submitters about uncertainty in OVERSEER N loss predictions. These concerns are more acute when OVERSEER is being used in a regulatory context like PC10. I cover those concerns below:

40. The science team responsible for developing OVERSEER advise that it is more appropriate to use the term 'uncertainty' rather than 'accuracy'. This is because it is not feasible to directly compare modelled losses with measured losses, other than on an intensively monitored research farm setting such as the 'farmlets' used to calibrate the model. Shepherd et al (2013) canvassed OVERSEER uncertainty and made several broad observations about reducing uncertainty, including:

[6] Table notes for Tables LR 1 and LR 2.
[7] Versions 5.4.9 and 5.4.11 were the main versions used during ROTAN development but they had very similar N losses for the same land use.

(a) Improvement will occur with ongoing model development, particularly additional calibration datasets that extend beyond the biophysical parameters of the current datasets[8].

(b) Comprehensive data input protocols are needed[9].

Local calibration of OVERSEER

41. OVERSEER has not been calibrated for Rotorua conditions, specifically high rainfall conditions. Field trials elsewhere in New Zealand used to calibrate OVERSEER were located on sites with less than 1500 mm annual rainfall (typically 800-1200 mm/yr) and the Rotorua catchment rainfall range is approximately 1300-2500 mm. OVERSEER can predict nitrogen loss outside its calibration range by applying known science principles, particularly around N cycling, soil properties, hydrology and climate. The predictive uncertainty of any biophysical model will be greater when it is applied outside the set of biophysical conditions used to calibrate the model. Council has recognised this issue and has addressed it in three ways:

(a) Council asked AgResearch to review available N leaching data from the Lake Rotorua catchment and compare it with OVERSEER N loss predictions. The data came from two sets of field trials run by AgResearch as part of recent SFF projects[10]. Both sites had below average rainfall for the catchment. The report concluded that:

'The analysis of these two trials showed that the comparison between measured vs. modelled N leaching values are reasonable when drainage values are aligned and the relativity of treatment effects (DCD, restricted grazing, reduced fertiliser) was of the right order' (Watkins and Selbie, 2015).

(b) In recognition that the two Rotorua SFF trials were on relatively drier sites and that national calibration datasets focus on sites with less than 1500 mm annual rainfall, Council initiated local OVERSEER calibration trials in April 2016. These are taking place on two dairy farms in the Lake Rotorua catchment, one on a pumice soil and the other is on a podzol soil. Historical data indicates that both sites receive at least 2000 mm annual rainfall (on average). The trials will run for three years and are being managed by

[8] Shepherd et al (2013) at [33].
[9] Shepherd et al (2013) at [35-36].
[10] The first SFF trial at Wharenui farm (dairy and drystock) ran 2005-2008. The second SFF trial was at Parekarangi Trust's dairy farm and ran from 2012-2015 with the final year being funded separately from SFF. However, the AgResearch N data review focused on just 2013-2014 due to 2012 being a 'settling-in' year and 2015 data was still being generated at the time of the review.

AgResearch with project funding from Council, DairyNZ and AgResearch itself. It is anticipated that, upon completion, trial results will enable calibration (or validation) of OVERSEER - this has been reinforced by a letter from Dr Caroline Reed, OVERSEER Ltd CEO.

(c) Method LR M2 provides for science and policy reviews every five years. Such reviews will be able to fully consider any OVERSEER improvements and changes in its calibration.

Use of data input standards and protocols to reduce variability

42. OVERSEER does generally assume best practice because it would not be possible to model the wide range of potential poor practices. However, it can model some 'poor' practices that tend to increase N losses, such as applying a large amount of N fertiliser in winter (Watkins and Selbie, 2015). The scope for unaccounted N losses from poor farm nutrient practices will be reduced (but not eliminated) though improved farmer awareness and engagement through the NMPs e.g. one of the NMP requirements is that 'fertiliser must be applied in accordance with the Code of Practice for Nutrient Management 2013 or as updated' (PC10 Schedule LR Six, clause 5(f)).

43. It is correct that different expert OVERSEER users can get different N loss rates for the same farm/year. This issue was noted by Shepherd et al (2013) and has since been partly addressed by the OVERSEER Ltd's Best Practice Data Input Standards (BPDIS, OVERSEER Ltd, 2016). The BPDIS was first introduced in 2013 and are updated with each OVERSEER version release. The national BPDIS includes flexibility for some OVERSEER input parameters within a preferential hierarchy i.e. users are encouraged to apply the 'best' data inputs (where available) but are not required. Given the importance of input consistency in the regulated Lake Rotorua catchment, Council developed a complementary suite of data input protocols that limit user discretion .

44. In addition to the national BPDIS and Council's local input protocols, Council also applies quality control checks to further minimise potential discrepancies in OVERSEER N outputs, as follows:

(a) PC10 NMPs and OVERSEER nutrient budgets must be prepared by a 'Suitably qualified and experienced person', approved by the Chief Executive (or delegate) of Council i.e. there is a potential sanction if high standards are not maintained.

(b) Council staff audit NMPs and accompanying OVERSEER files submitted by landowners and their advisors. These audits are occurring now (on provisional NMPs and OVERSEER files) and are expected to continue as PC10 progresses towards operative status.

45. In addition to the calibration and user/input variability issues canvassed in paragraphs 42 to 44 above, OVERSEER uncertainty is further reduced in PC10 through the consistent use of several biophysical input parameters that cannot be influenced by variable farm management. Even if OVERSEER is not accurately modelling the impact of these biophysical parameters, this 'inaccuracy' will largely cancel itself out when comparing different management scenarios on the same farm or on biophysically similar farms. These 'fixed' biophysical input parameters include:

(a) Soil type, determined by Landcare Research's S-map database which is now incorporated into OVERSEER

(b) Slope, determined by Council's GIS using accurate LiDAR data

(c) Rainfall and other climatic factors, determined by NIWA's virtual climate model incorporated into OVERSEER.

Compliance and OVERSEER N limits

46. There is no case law on enforcement against OVERSEER N limits imposed through regional plans and resource consents. While this is partly due to the relative novelty of such limits, it is a legitimate concern for submitters and Council. The concern is based on the difficulties of proving an adverse effect while acknowledging the uncertainty in OVERSEER predictions of that effect i.e. the degree of exceedance of any N limit. This concern is amplified by when version changes can result in different N loss predictions with no change in farm inputs.

47. PC10 largely addresses the OVERSEER compliance challenges by making the primary point of compliance the NMP (for activities requiring resource consent). While the NMP is based partly on an OVERSEER budget and OVERSEER-derived N limits, it also comprises a set of defined actions to be implemented over a five year period. These actions will include the areas for different land uses (e.g. dairy pasture, crop and trees), stocking rate and stock type, fertiliser use, effluent practice and imported feed. Most of these 'inputs' can be easily monitored by both the landowner and Council compliance staff i.e. NMP non-compliance can often be determined during a site visit.

Alternatives to using OVERSEER

48. Consideration of alternative methods to achieve control of nitrogen losses at the property scale need to be addressed in terms of the direction set by the (RPS) and current knowledge of nitrogen losses. The potential alternatives to using OVERSEER in PC10, and the reasons why they are not as effective as OVERSEER are shown in Table 1 below, adapted from Park (2014):

Table 1: Potential Alternatives to Using OVERSEER in PC10

Alternative to OVERSEER	**Reasons for not using the alternative**
Direct measurement by sampling groundwater	• Cost prohibitive, especially in the long-term • Practical difficulties in attributing measured N to a specific property and limitations in sampling methods • Measurement uncertainty may be comparable to modelling uncertainty i.e. there will be variability in results, even at the same sampling site, due to natural variability in addition to season and farm management variability
Other computer models	• No other model comes close in terms of: (i) applicability to a wide range of common New Zealand farm systems and practices; (ii) the use of readily available farm input data; (iii) a large pool of qualified users; (iv) almost 10 years of regular use in the Lake Rotorua catchment encompassing a large majority of the rural land subject to PC10. • It is accepted that OVERSEER does not model all possible situations (e.g. nurseries) and therefore provision has been made for alternative models (see proposed LR Rule R11). In practice, the use of an alternative model will still face challenges around the adequacy of input data and local calibration.
Good nutrient practices	• It is difficult to define good nutrient practices, especially to cover a wide range of farm system types and variation from farm to farm. Council, industry bodies and individual farmers will have different concepts of what constitutes good practice. • It is also difficult to quantify the level of N reduction from adopting 'good practice', especially given the context of the 435 tN target. • Moving away from a quantitative NDA as the basis for PC10 would also jeopardise the Incentives Scheme which relies on reductions below NDA quanta.
Input controls	• It would be possible to develop a suite of farm input limits to achieve large reductions in N loss. Limits would logically need to apply to those factors that significantly influence N leaching. However, there are many such factors:

	○ stocking rate and stock type ○ fertiliser type, rate and timing ○ area of crop, cropping practice and feeding regime ○ wintering practices ○ the amount and type of imported feed ○ constraints on land use change. • These limits would need to be set to accommodate a wide variety of farm systems and biophysical conditions i.e. they would be relatively complex with multiple weighting factors and caveats • As a potential input control system became more sophisticated, the closer it would get to replicating OVERSEER, but without the robustness, flexibility and institutional support that goes with OVERSEER • Input controls would be fixed for the life of the plan and therefore be inflexible and stifle farmer innovation

49. PC10 is not inflexible on using OVERSEER – it does provide for the use of alternatives to OVERSEER via policy LR P14 and rule LR R11 for situations where a property cannot be readily modelled by OVERSEER.

Managing OVERSEER version changes with the reference file method

50. The reference file method is described in Schedule LR Five. There are five reference files covering the five land uses that form the basis of the N allocation scheme in PC10's Schedule One. These land uses are: Drystock; Dairy; Plantation forestry; Native forestry; House block (i.e. rural houses with on-site waste treatment). Amendments to Schedule LR Five are recommended in Council's s42A report to clarify that there are five reference files in total, not two (drystock and dairy) – I support this clarification. The drystock and dairy reference files are described in detail in Perrin Ag Consultants report 'Methodology for creation of NDA reference files and stocking rate table Version 2' (February 2016) and in the evidence of Mr MacCormick.

51. Several submissions raised concerns that the drystock and dairy reference files were based on 'hypothetical 2032 future' farm systems and are not representative of current practices e.g. the reference files exclude cropping. This issue was discussed with several submitters at a meeting convened by Ms Burton on 15 September 2016, along with data analysis (prepared by Mr MacCormick) indicating the dairy reference file was not proportionally tracking the average of (available) dairy Rule 11 benchmark file N loss rates across recent OVERSEER version updates. The meeting consensus was to identify the cause of the non-proportional dairy tracking and to reconfigure both

dairy and drystock reference files to be representative of their respective benchmark datasets. These matters have been addressed in the evidence of Mr Matheson and Mr MacCormick and I concur with their recommendations to adopt amended reference files that generally represent the average of dairy and drystock benchmark farm systems.

52. The challenges associated with OVERSEER version management are covered earlier (para 32 to 35). The reference file method manages these challenges as follows:

(a) The reference files simulate a plausible 2032 farm system with lower N inputs (fertiliser and feed) and lower stocking rates than most current farm systems. As real farms get closer to their 2032 NDAs, many will also adopt lower input systems and therefore begin to resemble reference file farm system to a greater degree than their current (2016) farm system.

(b) The reference files deliberately avoid cropping despite this being relatively common in current Rotorua farm systems, albeit covering modest areas[11]. However, there has been more volatility across OVERSEER versions for crop block N losses than for pastoral blocks. Therefore, omitting crop blocks from the reference files reduces N loss volatility.

(c) The regulatory N limits for the 2022 MRT, 2027 MRT and 2032 are critical to determining each property's NMP. All NMPs have a five year life unless the property owner chooses to update them earlier e.g. to reflect a farm system change not anticipated when the NMP was written, including N trading. Therefore, the reference file system and its impact on regulatory N limits is only critical when NMPs are updated i.e. generally every five years.

(d) Rule compliance is anticipated to focus on the actions in the NMP in the first instance and these are not adjusted to reflect OVERSEER updates except when the NMP needs to be formally renewed. If there is a non-compliance with one or more specified NMP parameters (e.g. stock numbers), then Council staff may require an OVERSEER assessment to check compliance against the relevant quantitative N limit. This limit would need to be adjusted in accordance with the latest OVERSEER version reference file N loss and the relevant % value determined in the initial allocation.

[11] An assessment in 2013 of 13 Rotorua dairy farms showed an average fodder crop areas were 6% in 2001-2004 and 4% in 2012-2013 – see SFF report by Kingi et al (2015).

53. There are alternative methods to manage OVERSEER version updates, other than the use of reference files. These alternative methods and the reasons for not adopting them are set out in Table 2 below. More general methods to managing version updates (e.g. lock in a single version) are covered in paragraph 34 of my evidence.

Table 2: Alternative to the reference file method

Alternative method	Reasons for not using the alternative
Maintain individual property 'Starting Point' files to enable ongoing reassessment of that properties N limits	• Many smaller properties and those in the 'new' groundwater zone were never benchmarked and therefore they do not have a 'starting point' file to update • Since the end of the Rule 11 benchmarking period (June 2014), many properties have changed ownership or land use or size (due to subdivision and/or leases ending or beginning) and therefore the 'starting point' file may bear little relationship to the current property's status • The logistics of maintaining many individual property files in perpetuity are difficult and costly. Staff experience with the Rule 11 set of files has shown that file updating sometimes requires changes to file inputs to enable the file to run in a new version i.e. it is not a simple 'batch update' procedure (see Mr MacCormick's evidence for more detail).
Do not adjust property N limits	• This approach ignores the impact of version changes on property limits which would become easier or harder to meet over time in an unpredictable manner, creating uncertainty for landowners and overall catchment N reduction targets.
Adopt a 'farm portal' method similar to Environment Canterbury's Plan Change 3 to the Canterbury Land and Water Regional Plan	• The PC10 reference file method has some similarities to Ecan's Farm Portal i.e. maintaining broad relativity of regulatory N limits across version updates. However, the Lake Rotorua catchment has much less diversity in farm systems and biophysical conditions and therefore does not need the complexity of the Farm Portal system. • PC10 is based on sector specific reductions, not a mix of good management practice loss rates and reductions as in Ecan's Plan Change 3.

54. Ongoing OVERSEER development means progressive improvements to the model's predictive capability, even though the accompanying changes cause concerns for regulators and landowners. The value of improved science, including potential mitigations, outweighs the problems of changing N outputs

55. To summarise, the reasons for adopting the reference file method are:

(a) To allow the latest version of OVERSEER to be used with the 'best science', the fullest array of mitigations and model functionality, and the largest number of independent qualified expert users, all whilst;

(b) Maintaining the relativity of the initial N allocation distribution, including the differential allocation basis for the dairy, drystock and forestry sectors, and;

(c) Enabling a consistent, transparent, timely and cost-effective method of updating property N limits.

Response to submissions

56. The submitter concerns on the use of OVERSEER in PC10 (summarised in paragraph 21) include that OVERSEER is not used appropriately, it does not cover enough land uses and/or mitigations and that OVERSEER derived N limits are not enforceable. In my opinion, PC10 does use OVERSEER appropriately and in recognition of its limitations. I therefore consider that no OVERSEER-related amendments to PC10 are needed, except for an improved reference file method as explained below.

57. Several submitters criticised the dairy and drystock reference files for being based on overly-simplified hypothetical 2032 farm systems. After notification and consequent to the release of OVERSEER version 6.2.3, it also became apparent that the dairy reference file N loss was behaving differently from the average of the dairy benchmark files (see Mr MacCormick's EIC para 45-58). The combination of submitter concerns and Council data analysis led to Mr Matheson developing a new reference file method (Perrin Ag, 2016a) based on 2001-04 benchmark data. I concur with the opinions of Mr Matheson and Mr MacCormick that the new reference file system is better than the 'notified' method.

58. Submitters also queried the treatment of plantation forestry in Schedule Five, notably that there was no flexibility if OVERSEER estimates of forestry N loss change (currently fixed within OVERSEER at a single value of 2.5 kgN/ha/yr). This concern is compounded by Schedule Five not adequately explaining that there are three reference files (in addition to the dairy and drystock files) to cover the land uses of plantation forestry, bush/scrub and house blocks. I concur with the recommendation by Ms Burton (s42A report) to replace the existing Table LR8 in Schedule Five with a new table that adequately described the reference file parameters for plantation forestry, bush/scrub and house blocks. This amendment is particularly relevant to plantation forestry as it is likely that OVERSEER will, in the next few years, link to

'NuBalM' which is the forestry 'Nutrient Balance Model' developed by Scion. This will enable species, site, climate and management factors to be taken into account in estimates of N loss from plantation forestry.

Conclusion

59. In my opinion, OVERSEER is used appropriately in PC10 to set N limits and to help determine compliance against those N limits, particularly through the intermediary mechanism of actions defined within a property NMP. It is also my opinion that the reference file method, subject to the modifications noted in my evidence (and canvassed in detail within the evidence of Mr Matheson and Mr MacCormick), will adequately manage OVERSEER version updates into the future.

Appendices

- Appendix A is a reference list for documents used in this evidence
- Appendix B describes Simon Park's other contractual relationships regarding technical expertise related to this evidence
- Appendix C listing recommendations from 'Using Overseer within Rules for the Lake Rotorua Catchment' (Park, 2014).

Name: Simon Park

Date: 17 January 2017

Appendix A: References

Arbuckle, C. (2015) Stocktake of Regional Council Uses of OVERSEER®. Report no.001. Report prepared for MPI and BOPRC.

Freeman M, Robson M, Lilburne L, McCallum-Clark M, Cooke A, & McNae D (2016): Using OVERSEER® in regulation - technical resources and guidance for the appropriate and consistent use of OVERSEER® by regional councils, August 2016. Report prepared by Freeman Environmental Ltd for the OVERSEER Guidance Project Board

Kingi T, Park S and Scarsbrook M (2012): Solutions for a Sustainable Lake Rotorua: The Farmers' Perspective. FLRC Proceedings 2012.

OVERSEER Ltd (2016): OVERSEER® Best Practice Data Input Standards, OVERSEER Version 6.2.3, November 2016, retrieved 29 November 2016 from www.overseer.org.nz/user-guides

Park S (2014): Using OVERSEER within Rules for the Lake Rotorua Catchment. Headway Ltd., Report prepared for Bay of Plenty Regional Council.

Park S, Kingi T, Morrell S, Matheson L and Ledgard S (2014): Nitrogen Losses from Lake Rotorua Dairy Farms - Modelling, Measuring and Engagement. FLRC Proceedings 2014.

Perrin Ag Consultants Ltd (2016): Methodology for creation of NDA reference files and stocking rate table Version 2. Report to Bay of Plenty Regional Council dated February 2016.

Perrin Ag Consultants Ltd (2016a): Methodology for and output from further revision of NDA reference files. Report to Bay of Plenty Regional Council dated December 2016.

Shepherd, M., Wheeler, D., Selbie, D., Buckthought, L. & Freeman, M. (2013) OVERSEER®: accuracy, precision, error and uncertainty. In: Currie, L. D. & Christensen, C. L. (eds.) Accurate and efficient use of nutrients on farms. Fertilizer and Lime Research Centre, Massey University, Palmerston North, New Zealand.

Watkins, N. & Selbie D. (2015) Technical description of OVERSEER for Regional Councils. AgResearch Contract Report RE500/2015/084.

Appendix B: Simon Park's other contractual relationships regarding technical expertise related to this evidence

60. I contracted with Ballance Agri-Nutrients Ltd in 2010 to help write a funding application to the Primary Growth Partnership (PGP) which is managed by Ministry for Primary Industries. The approved application became known as 'Clearview' and it includes the development of the nutrient management tools 'MitAgator' (focusing on contaminant Critical Source Areas) and 'N-Guru' (optimising soil and fertiliser nitrogen).

61. I contracted with the Fertiliser Association of New Zealand (FANZ) in 2011-2012 to prepare another PGP application that canvassed aspects of OVERSEER's development and use and the certification of its users. While the PGP application was

unsuccessful, FANZ decided to establish a certification scheme under its subsidiary 'Nutrient Management Adviser Certification Programme Ltd' (NMACP Ltd). In mid-2016, I was contracted by NMACP Ltd to write a 'RMA module' for the continuing professional development of nutrient advisers. I intend to carry out further consultancy work with FANZ.

62. I contracted with Dairy NZ in late 2011 to provide support services to the recently formed Lake Rotorua Primary Producers Collective (the 'Collective'). In mid-2012 this minor support role was superseded by a contract with Bay of Plenty Regional Council and continued through to October 2015. The purpose of the support role was to assist farmer members to understand and engage with nutrient policy and the associated science. I participated in numerous Collective meetings and helped them to develop their 2013 nitrogen allocation proposal under direction by the Collective's then Chairman, Dr Tanira Kingi. I always took care to remind the Collective's leadership that I was working with them on behalf of BOPRC to achieve the statutory targets in the Regional Policy Statement, specifically to achieve the lake annual nitrogen load of 435 tonnes by 2032.

63. In 2014 Landconnect Ltd developed the Collective's website www.rotoruafarmers.org.nz and regular e-news as part of the support contract with BOPRC. This technical work was carried out by my partner (and Landconnect co-director) Maggie Hope. Although I am no longer personally involved in any Collective support role, Landconnect (through Maggie Hope) continues to provide web technical support to the Collective under a separate contract for services (funded by the Collective).

64. I contracted with AgResearch from 2012 to 2015 to assist with managing the Sustainable Farming Fund (SFF) project 'Meeting nutrient loss targets on dairy farms in the Lake Rotorua catchment'. This project was initiated in 2011 by Rotorua dairy farmers shortly before they formalised the Collective as an incorporated society. Dr Tanira Kingi (then employed by AgResearch) was the project leader and I assisted him with project documentation, progress reports, liaison work and field days.

Appendix C: Recommendations from 'Using Overseer within Rules for the Lake Rotorua Catchment' (Park, 2014)

NB: My 2014 recommendations are annotated to refer to relevant paragraphs of my evidence.

Recommendation 1: Specify that the latest version of Overseer is always used[12].

Recommendation 2: Base the NDA rule on the quantum of N reduction needed between (i) farm N loss assessed in the rule commencement year(s) and (ii) the farm's allocated 2032 NDA. Compliance with the N reduction quantum can be based on re-using inputs from the rule commencement year(s) and the current year(s) using the latest Overseer version[13].

Recommendation 3: Rule compliance is assessed against N loss over a three year rolling average.

Recommendation 4: Require that Overseer users are certified nutrient management advisors and that the latest Overseer Best Practice Data Input Standards are complied with[14].

Recommendation 5: BoPRC should investigate, with AgResearch and Overseer Management Services, the benefits and costs of local field trials to improve Overseer calibration for local conditions. This should take into account the current Sustainable Farming Fund work at the Parekarangi Trust dairy farm (SFF11-023) and the scope for aligning with other regional councils considering similar trials[15].

Recommendation 6: Ensure integration between Overseer modelling at the farm scale and catchment modelling so that NDA farm limits are transparently linked to catchment nitrogen targets.

Recommendation 7: Liaise with the Overseer owners and other regional councils to develop secure efficient national database systems for maintaining, updating and accessing Overseer input and output data.

Recommendation 8: Require that farm nutrient management plans be prepared according to a schedule of minimum criteria. Plans must demonstrate how NDA compliance, or progression towards that limit, will be practically achieved over a 5 year period. The rules should enable use of industry-driven EMS where they meet the criteria[16].

Recommendation 9: In collaboration with rural industry agencies, enhance the efficacy of farm nutrient plans by developing:

(i) relevant minimum farm nutrient plan criteria

(ii) protocols on compliance with farm nutrient plan provisions in addition to Overseer-based quantitative N losses

(iii) good management practices to reduce phosphorus losses, particularly from "critical source areas", for incorporation within farm nutrient plans.

Recommendation 10: Allow nutrient budget models other than Overseer to be used to show compliance and support farm nutrient plans, subject to satisfactory model performance and approval by BOPRC senior management[17].

In conclusion:

Recommendation 11: The Overseer nutrient budget model is fit for the purpose of regulating N loss in the Lake Rotorua catchment.

[12] See paragraph 50 of my evidence where I address PC10's use of reference files instead, and paragraph 51 where I explain how an amended reference file method would be an improvement to the notified version.

[13] See footnote 12

[14] See paragraph 43 of my evidence where I have updated this recommendation to include the complementary data input requirements developed by Council.

[15] See paragraph 41 of my evidence where I describe the current high rainfall Rotorua calibration trials.

[16] See Schedule LR Six of PC10 and the evidence of Mr Lamb.

[17] See rule R11 of PC10 and paragraphs 48 and 49 of my evidence.