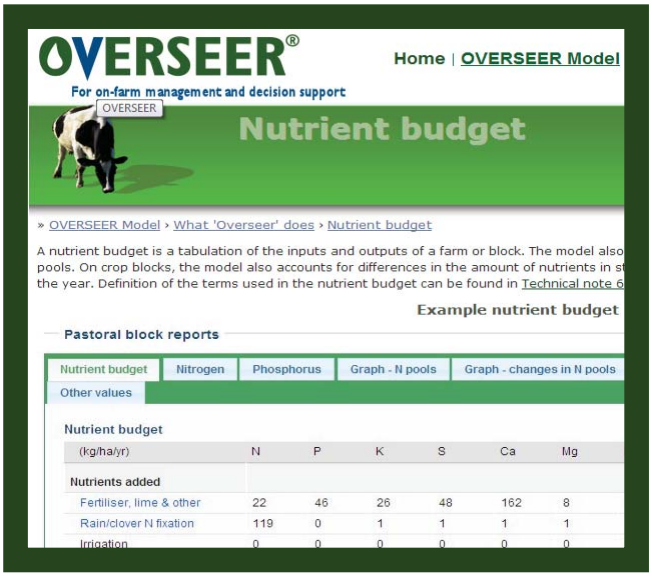
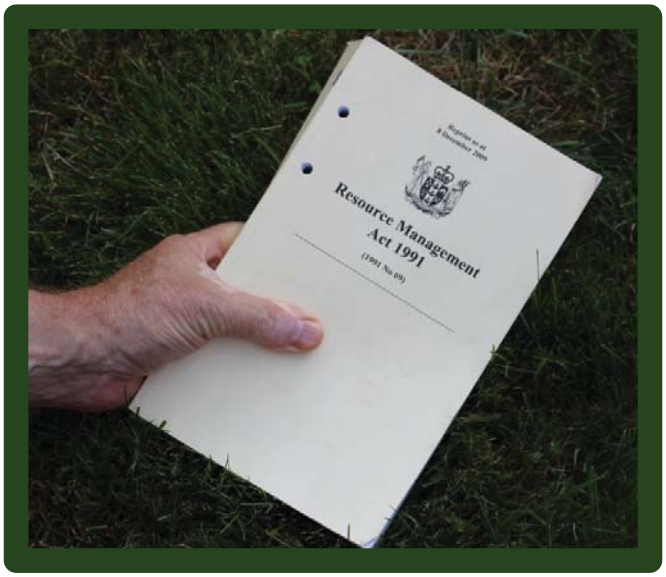


Using Overseer within Rules for the Lake Rotorua Catchment



A report prepared by Simon Park, Headway Ltd

for the Bay of Plenty Regional Council

6 March 2014

Executive Summary and Recommendations

The Bay of Plenty Regional Council is considering if and how to use the Overseer nutrient model to regulate reduced nitrogen losses in the Lake Rotorua catchment. It is envisaged that individual properties, especially pastoral farms, will be required to meet a quantitative "nitrogen discharge allowance" (NDA) by 2032. The regulated NDA levels, in combination with a nitrogen reduction incentives scheme and a gorse replacement project, is designed to meet the Proposed Regional Policy Statement sustainable N load target by 2032. The core rules and incentives policy package, including NDA rules, is currently being developed collaboratively through the Lake Rotorua Catchment Stakeholder Advisory Group (StAG).

This report summarises the regulatory and practical challenges in using Overseer within potential Rotorua catchment rules and makes recommendations in respect four key questions:

1. Will Overseer estimates of N loss be "good enough" in terms compliance, N purchase (incentives) and N trading (between farmers)?
2. How should NDA rules account for Overseer version changes?
3. How should Overseer uncertainty be accounted for in the NDA rules?
4. How should farm nutrient management plans be linked to Overseer and the NDA rules?

The key questions were identified and assessed through three related pieces of analysis:

- An expert workshop held on 15 November 2013
- A review of Overseer literature and regional plans that incorporate Overseer
- Analysis of the strengths and weaknesses of options for each question

The following recommendations are made in respect of NDA rules for the Lake Rotorua catchment:

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

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.

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.

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.

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 to 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.

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.

In conclusion:

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

Authorship, Disclaimer and Acknowledgement

This report has been prepared on behalf of BOPRC by Simon Park of Headway Ltd, Tauranga. Contact details are: 07 5702484, 0274 323929, simon.park@xtra.co.nz.

While this report has been prepared in response to a project brief from BOPRC policy staff, all opinions expressed are those of the author Simon Park.

The input from participants and support from BOPRC staff at the project workshop held on 15 November 2013 is gratefully acknowledged.

The simple "Overseer" lower-case formatting has been used throughout this report for ease of use. The author notes that the formal usage is normally OVERSEER®.

Table of Contents

Executive Summary and Recommendations 2
1 Background 5
1.1 Lake Rotorua Catchment Policy Context 5
1.2 Background on the Overseer model 5
2 Methodology 7
2.1 Literature review 7
2.2 Project workshop 7
2.3 Options Analysis and Synthesis 8
3 Lessons 8
3.1 Lessons from the literature review 8
3.2 Lessons from the workshop 9
4 Options Analysis and Synthesis 10
4.1 Options to reference Overseer versions within rules 10
4.2 Managing different outputs from different Overseer versions 12
4.3 Addressing Overseer Uncertainty 14
4.4 Rule linkages to Farm Nutrient Plans 17
4.5 Is Overseer fit for purpose? 18
Appendix A: Regional plan review 21
Appendix B: Literature review of Overseer-related documents 28
Appendix C: Workshop Summary 35

1 Background

A summary of the Rotorua policy and Overseer technical background is provided below.

1.1 Lake Rotorua Catchment Policy Context[1]

BOPRC aims to have draft NDA rules for the Lake Rotorua catchment prepared by June 2014 for consideration by Council prior to public consultation in July to October. Formal notification of a proposed plan change incorporating the new rules in scheduled for early 2015. Based on the "Rules and Incentives" framework approved by BOPRC in September 2013, and subsequent consideration by the Stakeholder Advisory Group (StAG), it is expected that **rules will allocate property Nitrogen Discharge Allowance (NDA) on a historic sector land use basis with NDAs to be met by 2032, with sectors limited to dairy, drystock and trees.**

The NDAs aim to reduce annual N discharge by 140 tonnes (tN) by 2032 relative to historic pastoral levels[2]. An incentive scheme will aim to remove 100 tN by 2022, complemented by a parallel gorse removal scheme targeting a 30 tN reduction i.e. the total N reduction needed from the pastoral sector is 270 tN. Groundwater lags means it will take longer than 2032 to meet the 435 tN target as N load to the lake.

The draft rules and incentives package focuses strongly on nitrogen. The science consensus (Water Quality Technical Advisory Group) is that Lake Rotorua is N and P co-limited. It is anticipated that P can be controlled by in-lake actions (e.g. alum dosing in the short term) and/or by catchment P reductions associated with (or complementary to) N reductions, especially land use change from pasture to trees. Therefore pastoral N reductions are the key policy focus.

The NDA rules being developed for the Lake Rotorua catchment will be the "second generation" of NDA rules for this catchment. The operative Regional Land and Water Plan has a suite of grandparenting rules known as "Rule 11" – these cap N and P loss from properties over 0.4ha in five lake catchments, including Lake Rotorua. The Rule 11 database enables us to summarise N loss rates across different land uses and to test the likely level of NDA reduction under new rules. The grand-parenting nutrient rules are interim rules and, for the Lake Rotorua catchment, are subject to a current rule development process as mandated by the Regional Policy Statement Policies WL 1B-6B. It is possible that the new NDAs will be based partly on the Rule 11 benchmark N loss through a hybrid range formula. One hybrid formula considered by StAG is 75% of the Rule 11 N level subject to maximum/minimum ranges of 30-40 kgN/ha/yr for dairy, and 10-20 kgN/ha/yr for drystock, with trees fixed at 3 kgN/ha/yr – with land use defined by the 2001-2004 benchmark period.

The NDA and incentive options are complex and no firm decisions have been made by BOPRC. More detail on the policy context is in the workshop report in Appendix 1, particularly the notes on Sarah Omundsen's policy overview and Penny MacCormick's Rule 11 overview. A more comprehensive summary and associated policy documents can be found at http://www.rotorualakes.co.nz/rotorua_rules_incentives.

1.2 Background on the Overseer model

Overseer is a freely-available farm scale nutrient budget model that was first developed in New Zealand over 20 years ago, initially as a fertiliser recommendation model. It has progressively developed to cover a wide range of nutrients, farm systems, physical conditions and methods to manage or mitigate nutrient and other emissions or uses (water, energy, greenhouse gases). Although it is an expert system, it is designed to use

[1] The background is drawn partly from material prepared for the 15 November 2013 Overseer RMA workshop.
[2] The key "historic" N loss levels are those used in the ROTAN catchment modelling with 2010 losses assumed to average 56 kgN/ha/yr for dairy and 16 kgN/ha/yr for drystock, based on various Overseer 5.4 assessments.

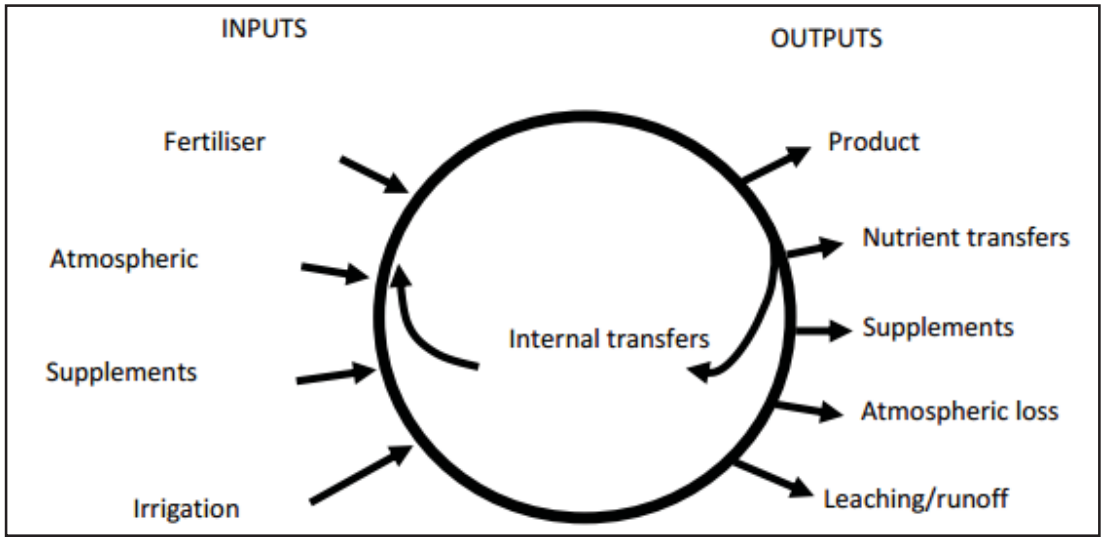
readily available farm input parameters. The increasing challenge of management diffuse nutrient losses from farms has seen regional councils adopt Overseer as both an advisory and regulatory tool.

The Overseer website (http://www.overseer.org.nz/) describes Overseer as follows:

> OVERSEER® Nutrient Budgets is an agricultural management tool which assists farmers and their advisers to examine nutrient use and movements within a farm to optimize production and environmental outcomes. The computer model calculates and estimates the nutrient flows in a productive farming system and identifies risk for environmental impacts through nutrient loss, including run off and leaching, and greenhouse gas emissions.

A technical note on Overseer website provides a useful schematic on the core nutrient budget component of Overseer, which is reproduced below as Figure 1 (link). Please note the multiple system inputs and outputs, whereas N regulation generally focuses solely on the "leaching/runoff" component.

Figure 1: Diagrammatic example of a nutrient budget



Overseer is jointly owned by the Ministry for Primary Industries (MPI), the Fertiliser Association of New Zealand (FANZ) and AgResearch. The Vision for Overseer is:

> A robust, science-based decision support tool and policy support tool that is widely used for improving farm profitability, optimising nutrient use and minimising impacts on air, soil and water quality."

The effective use of Overseer requires the user to enter actual and reasonable input values to represent the current farm – this requires a good understanding of farm systems in general and of the farm being modelled in particular. Undertaking 'what if' analyses using Overseer requires a higher level of understanding of farm systems (paraphrased from https://secure.overseer.org.nz/live/Content/Help/Content/Getting_Started.pdf).

2 Methodology

The methodology for this report is based on combining lessons from (i) a literature review, (ii) advice from the project workshop (15 November 2013) and (iii) a basic options analysis. For each of these three elements, a set of four themes and corresponding research questions were posed, described in Table 1 below:

Table 1: Research themes for this project

Theme	Question
1. Overall fit-for-purpose	Will Overseer estimates of N loss be "good enough" in terms compliance, N purchase (incentives) and N trading (between farmers)?
2. Version	How should NDA rules account for Overseer version changes?
3. Accuracy	How should Overseer uncertainty be accounted for in the NDA rules?
4. Integration with farm plans	How should farm nutrient management plans be linked to Overseer and the NDA rules?

These four research themes were derived from discussion with BOPRC staff prior to the project workshop, with a larger number of "secondary" questions set aside (the secondary questions are noted in the workshop summary appended to this report). Discussion at the project workshop confirmed that these four themes/questions were the top priorities when considering if and how to use Overseer within RMA rules.

The three main project methodology elements are described below.

2.1 Literature review

The project literature review was split into two parts: (i) a review of regional plans across New Zealand where Overseer features in nutrient rules (ii) relevant recent documentation on Overseer. Both parts of the review relied on the author's knowledge, advice from workshop participants and Google searching for combinations of relevant keywords i.e.: Overseer, nutrient, nitrogen, version, accuracy, farm plans and synonyms of these.

The regional plan review is presented as a large table in Appendix A using the following headings:

- Plan and Status Type of N rule and N limit
- Overseer version
- Accuracy
- Data control
- Links to other tools/methods (this includes farm plan methods)

The review of recent documentation is presented as Appendix B in the style of an annotated bibliography. The review of revealed a large number of technical reports on Overseer's development, calibration and various applications, particularly scenario testing of status quo and mitigation options. Only a few of these are included as the emphasis was on the use of Overseer within RMA rules. The latter emphasis lead to the inclusion of several expert evidence statements and Court decisions associated with recent RMA plan changes.

The key lessons from both parts of the literature review are summarised in Section 3.1 of this report.

2.2 Project workshop

A one-day exert workshop was held on 15 November 2013 with 22 attendees covering a range of representatives from industry, AgResearch, agricultural consultants, MPI, MfE, a local farmer plus regional council staff (BOPRC, Waikato and Horizons).

Details of the workshop structure, presentations and participant discussion are given in Appendix C. The key workshop methodology steps were:

(i) Participants were selected based on their expertise with farming, Overseer, RMA policy and implementation.

(ii) Background material was pre-circulated, including the Lake Rotorua policy context and a set of primary and secondary RMA-Overseer questions.

(iii) The workshop agenda was:

- Welcome and Overview – Simon Park
- Rule 11 and Overseer – Penny MacCormick
- Local policy context – Sarah Omundsen, Lisa Power
- Overseer history, governance and development – Greg Sneath
- Overseer science, uncertainty and version issues – David Wheeler
- A farmer perspective – Stuart Morrison
- 1st Workshop session: What are the key Overseer questions for Rotorua?
- 2nd Workshop session: Answering the key Overseer-RMA questions
- Identify further work needed
- Wrap up

(iv) A draft workshop report was circulated to attendees on 5 December and feedback invited. Workshop discussion highlighted that the Overseer version theme was the most difficult issue and therefore the draft workshop report incorporated an initial versions options analysis to prompt more specific feedback.

(v) Lessons from the workshop, including post-workshop feedback, have been incorporated throughout this report.

2.3 Options Analysis and Synthesis

The workshop and literature review identified a series of distinct options to address the version theme – therefore an explicit options analysis is carried out in Section 3.2. A more basic options analysis is carried out to address the themes of Overseer uncertainty and farm plan linkages. The broader Overseer "fit-for-purpose" theme is considered in light of the foregoing options analyses and be reference to key Court decisions and workshop discussion i.e. although this was posed as the first theme/question, it is logical to address it last.

3 Lessons

3.1 Lessons from the literature review

Based on the regional plan and document reviews in Appendices A and B (respectively), a set of key lessons has been distilled:

Diversity of approaches

The 10 regional plans reviewed in Appendix 10 take very diverse approaches to using Overseer within regional rules, reflecting:

- Different biophysical drivers such (i) as a need to manage farm loss of N, P or both N and P (ii) whether a catchment was considered under or over-allocated e.g. HBRC's Tukituki Plan Change 6 is predicated on there being significant scope to increase N losses from the proposed Ruataniwha Water Storage Scheme because the receiving waters are mainly P limited.

- Variable political and/or management preferences for non-regulatory or regulatory approaches, including the attribution of consent activity status. This may also relate to the degree of development pressure, including from an expanding and intensifying dairy sector.
- Passage of time – both Overseer and nutrient policy have evolved rapidly over the past decade e.g. the 2011 NPS for Freshwater Management now required all regional authorities to impose water quality limits on all water bodies and identify a path to achieve those limits.
- Lack of national guidance on how to use Overseer in rules, combined with limited policy case law and no enforcement case law.

Growing use of Overseer within rules

Notwithstanding the diversity of rule approaches, Overseer is now seen by most if not all regional councils as a key tool to monitor and regulate diffuse nutrient loss from farms. This growth is occurring despite awareness of Overseer's limitations and the uncertainty of modelled N loss rates.

Improved institutional capacity around Overseer

The Overseer owners have been proactive in building enduring institutional capacity to support and further develop Overseer, including:

- Explicit Overseer governance, management and research strategies and functions
- Overseer technical manuals, input standards, nutrient management training (via Massey University), user certification and continuous professional development
- Data integration with NIWA rainfall models, Landcare's S-map soils database and detailed slope maps (and categorisation) derived from LIDAR
- Web-based and standalone versions of Overseer
- New farm systems (e.g. dairy goats, winter barns) and mitigations continue to be added.

Integration with farm nutrient plans

Most of the regional plans made strong linkages between an Overseer based N limit and some form of farm nutrient plan – the latter's terminology (and wider functions) varies greatly. This reflects that farmers and regulators (both Council and industry EMS) need a pragmatic means of implementing a nutrient limit.

3.2 Lessons from the workshop

The key messages from the workshop are recorded in the workshop report (Appendix C) in several "text boxes" throughout that report. A broad summary of those workshop messages is provided here:

- There was a broad consensus from the diverse range of participants that Overseer was critical to addressing diffuse farm nutrient losses and there is no practical alternative. However, it must not be used in isolation i.e. supporting tools like farm plans and extension services are needed.
- Common, nationally consistent approaches are needed on managing Overseer use within rules, version issues and ongoing data management.
- There is widespread concern at how different versions change the N loss rates for the same farm system.

- There is some ongoing tension from parts of the rural sector that Overseer was developed initially as an advisory tool and is not appropriate for enforcing "hard" quantitative nutrient loss limits.
- In many catchments it is more important to get farmers moving in the right direction (reducing nutrient loss!) rather than focusing on a specific end point.

4 Options Analysis and Synthesis

To recap, the potential use of Overseer in Lake Rotorua catchment rules is assessed across four key themes:

(i) Version, (ii) Accuracy, (iii) Integration with farm plans and (iv) Overall fit-for-purpose

Although listed earlier as the first question, whether Overseer is "fit-for-purpose" is consequent to the other three questions and will therefore be addressed last.

4.1 Options to reference Overseer versions within rules

Context: Overseer is typically updated several times per year to reflect new science, new farm systems, new mitigations, user interface improvements and bug fixes. Updates and the user licence system are configured so that older versions are overwritten. This ensures that all users have the most up to date model tool and which can be applied uniformly around New Zealand. Exceptions can be made by agreement with the Overseer owners, notably the ongoing support of Version 5.4.3 for regulatory use in the Taupo catchment. As more Overseer users migrate to the web-based version (with cloud storage of farm files) it appears likely that using the latest version will become more "automatic".

Legal constraints: Particular challenges in referencing Overseer within RMA plans (and rules) are the restrictions imposed by RMA Schedule 1 Clauses 30-35. These clauses enable external documents and "methods" to be incorporated in a plan rule by reference but emphasise the need for a specific document title and date to provide certainty for plan users. Useful guidance is provided at the Quality Planning website here, notably that any updated versions of documents and methods can only have legal effect via a specific plan change process i.e. there is no automatic update.

The review of 10 regional plans across seven regional councils revealed a range of approaches to Overseer version issues, as shown in Table 3 below:

Table 3: Regional Plan Approaches to Overseer Versions within nutrient rules

Option	Number of plans	Which regional plans?
No reference	5	Waikato, BoP RWLP, Horizons POP, Hurunui-Waiau, Southland RWP
Latest version	3	Tukituki, Canterbury NRRP, Canterbury L&WP
Specified version	2	Taupo RPV5, Otago RWP Change 6A

POP did not specify any Overseer version, as covered in this report's Appendix A review of regional plans. The High Court in 2013 found that although Overseer was a "method" in terms of Schedule 1, the relevant rule (POP Rule 13.2) focused primarily on Nutrient Management Plans (NMPs) with Overseer one element of such NMPs. Further, NMPs are linked to an external document i.e. NMPs must comply with the 2007 Nutrient Management Code of Practice.

In contrast, the Hearings Panel decision report for Otago's Water Quality Plan Change 6A makes explicit reference to RMA Schedule 1 in justifying the reference to Version 6.0 of Overseer within Rule 12.C.1.3.

Based on the High Court's POP determination, it appears that it is possible to allow the latest version of Overseer to be used without expressly requiring that within the rule wording. However, the more recent deliberations for the Canterbury Land and Water Regional Plan (recommendations made December 2013) explicitly state that the latest version of Overseer should be used.

The strengths and weaknesses of several Overseer version referencing options are canvassed in Table 2 below.

Table 2: Options to address Overseer version changes within rules

Version Option	Strengths	Weaknesses
1. Do not specify a version	• Supported through recent Environment and High Court litigation re One Plan • Flexible	• Defers key decisions with ongoing negotiation needed • Uncertainty • RMA Schedule 1 Clause 30-35
2. Specify a version in the rule	• Certainty for farmers • Certainty for Council on assessing aggregate progress to catchment N load target • Fair comparison between NDA and actual N loss • No NDA recalculation	• Becomes gradually obsolete by not adopting latest science, farm systems and mitigations • Requires separate contract and funding to maintain version usability • Out of step with all other uses and users of Overseer • Risk of specifying a version with significant bugs • Plan change needed to update
3. Specify that the latest version is always used	• Always up to date • Latest mitigations and farm systems included • Consistency amongst expert users • Owner support • AgResearch technical support	• NDA recalculations needed OR • New versions will impact farm compliance with NDA • Perception risk with "frequent" changes • Bugs can cause anomalies until fixed
4. Specify a version time window e.g. every 5 years	• Partly up to date • Recalculation of NDA can be anticipated and planned for	• Partly obsolete and out of step with other RCs before updates occur • Requires Overseer owner and expert support to maintain version usability • Arbitrary anniversary date may "capture" a version with bugs
5. Specify major updates only e.g. 6.x.x until 7.x.x is available	• Partly up to date • Recalculation of NDA can be anticipated (with Overseer owner support) and planned for	• Requires Overseer owner cooperation on planning update release timing • Variable loss of relativity with "minor" updates between major updates
6. Modified Fisheries ITQ (individual transferable quota)**	• Shifts focus partly away from Overseer • Fair as each farm target is a constant share of total catchment allocation target	• More analysis needed! • Complex, novel, new analysis needed e.g. would RMA need to be amended? • Overseer updates still needed behind ITQ system

*Recalculation of NDA – this concept needs clarification. It basically relies on using a consistent set of input parameters (defined for each farm) every time Overseer is updated.

Based on the Overseer version options analysis above, the following recommendation is made:

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

Comment: Rules that use the latest Overseer version had near unanimous support at the project workshop, particularly because it maintains NZ-wide consistency, institutional support and incorporates the latest science, farm systems and mitigation options. However, the version referencing challenge imposed by RMA Schedule 1 Cl. 30-35 suggest legal advice on specific rule wording and structure is required.

4.2 Managing different outputs from different Overseer versions

If the latest Overseer version is always to be used (Recommendation 1), then the challenge becomes how to effectively deal with different versions giving different N loss outputs for the same inputs, noting that:

- even minor version updates may give different N outputs
- the efficacy of specific mitigations may change with implications for compliance and N purchases/trades that rely on those mitigations
- relativity between farms may change as new/improved science is incorporated into Overseer, possibly driven by changed model responses to:
    - soil type – this includes the integration of detailed S-map data on soils
    - higher rainfall – understood to be a key impact from version 5 to 6
    - farm system – for example, dairy wintering-off efficacy decreased when research showed urine deposition as early as February still had a significant effect on winter N leaching
- Local calibration trials that improve model predictions still represent a (likely) change in N loss rates.

In addition to these listed "technical" issues, certainty and fairness is desired by farmers and regulators. Certainty is also a core RMA rule-drafting principle. The key criteria from the project workshop, Overseer guidance material and expert evidence (notably the Tukituki Board of Inquiry), includes:

- Make N loss comparisons within the same version. This entails maintaining historic farm input data to enable same-version comparisons with current or future farm scenarios
- Focus on proportional (percentage) change where possible, rather than relative to a fixed N loss value

For Rotorua, the proportional change criteria needs to work as a large reduction from a current or historic level of N loss, with both assessed using the latest version of Overseer. This is more difficult that maintaining a benchmark (effectively 0% change e.g. Taupo catchment) or allowing some increase because there is some N load "headroom" e.g. the 10% threshold in the Tukituki Proposed Plan Change 6, Rule TT1, noting the 10% trigger in TT1 is also paired with a numeric trigger of 5kgN/ha/yr.

Rotorua NDA context: The "benchmark" Overseer value can be either the Rule 11 benchmark or a "new" benchmark such as the year the rule has legal effect. The draft N allocation policy[3] envisages either single sector NDAs (e.g. 35 kgN/ha/yr for dairy based on 2001-04 land use) or a comparable range (e.g. 30-40 kgN/ha/yr). It is possible that the NDA range will be based on a percentage reduction from the Rule 11 2001-04 benchmark (e.g. 25%), along with other allocation criteria that may be adopted[4], that:

[3] Draft policy based on the Framework presented to BOPRC's Strategy Policy and Planning Committee September 2013 and subsequent development by StAG, notably the NDA range option discussed November 2013 - see StAG minutes link

[4] No firm policy decisions have been made by BOPRC and the indicative NDA policy advice being developed at StAG may change significantly before and after formal plan change notification, expected early 2015.

- sets a quantitative upper N loss limit bound
- does not require N reductions from land that already has low N loss
- possibly accounts for rainfall and soil type
- possibly accounts for and pre-2001 retirement of productive land (e.g. LUC 6 or better)
- ensures total N load from land currently in pasture is reduced to 386 tN/yr.

While not all these factors may be adopted by BoPRC, the key point is that the policy path is heading towards allocating individual quantitative property NDAs. This implies that in order to apply a proportionality-based Overseer rule, the proportional reduction would need to be customised for each property.

It is envisaged that the Lake Rotorua policy package will also allow N trading between farmers (for flexibility) and N purchases (retirement) by a public incentives fund. Both N trading and N purchases will necessarily be quantitative (kg or tN), not proportions of a historic N loss quantum. It is therefore logical to focus on the reduction quantum rather than reduction proportion.

The following example illustrates how a rule could focus on the N reduction quantum required, not the NDA:

Hypothetical Dairy Farm NDA example

i. An individual dairy farmer is allocated a NDA of 35 kgN/ha/yr to be met by 2032

ii. The farmer has a current N loss of 50 kgN/ha/yr (base on "current" input data, say 2014), requiring a reduction of 15 kgN/ha/yr, equating to a 30% reduction. Other farmers will have different quantum reductions but all can be calculated the same way.

iii. The RMA rule focuses on the required quantum reduction. Future compliance is assessed on the quantum difference arising from re-using the (say) 2014 input data with the future input data, both in the same future Overseer version.

The main **advantages** of basing the NDA rule on the reduction quantum (15 kgN/ha/yr in above example) are:

- A simplified comparison between historic and current/future scenarios for the same farm
- Compatibility with N trading and N purchases
- The essence of proportional reduction is still maintained
- Aggregate progress can be readily assessed, including progress consistent the RPS Policy WL6B of "managed reduction" through to 2032.

The main **disadvantages** of basing the NDA rule on the reduction quantum, and not a end-point NDA, are:

- The reduction quantum is only assessed upon commencement of the rule and the aggregate farm N reductions may be under or over that required, depending on the impact of future Overseer versions
- More significantly, the aggregate of all N reductions may be under or over that required, placing the catchment reduction target at risk.

The risk of over-achieving the catchment reduction target is that more economic and social harm occurs than necessary. However, it is feasible that: (i) progress reviews could alert policy makers to amend the rule by a plan change or (ii) the additional aggregate N reduction is a form of "insurance" against underperformance by other policies, notably the incentives fund. The major policy risk is under-achieving the catchment target. While that could also be addressed through a plan change, it would face farmer resistance compared with a plan

change that eased N constraints. This policy risk must be weighed up alongside other policy risks and uncertainties and is beyond the scope of this report.

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.

4.3 Addressing Overseer Uncertainty

From a regulatory perspective, Overseer-based nitrogen limit rules need to provide certainty to users, regulators and the wider community in order to:

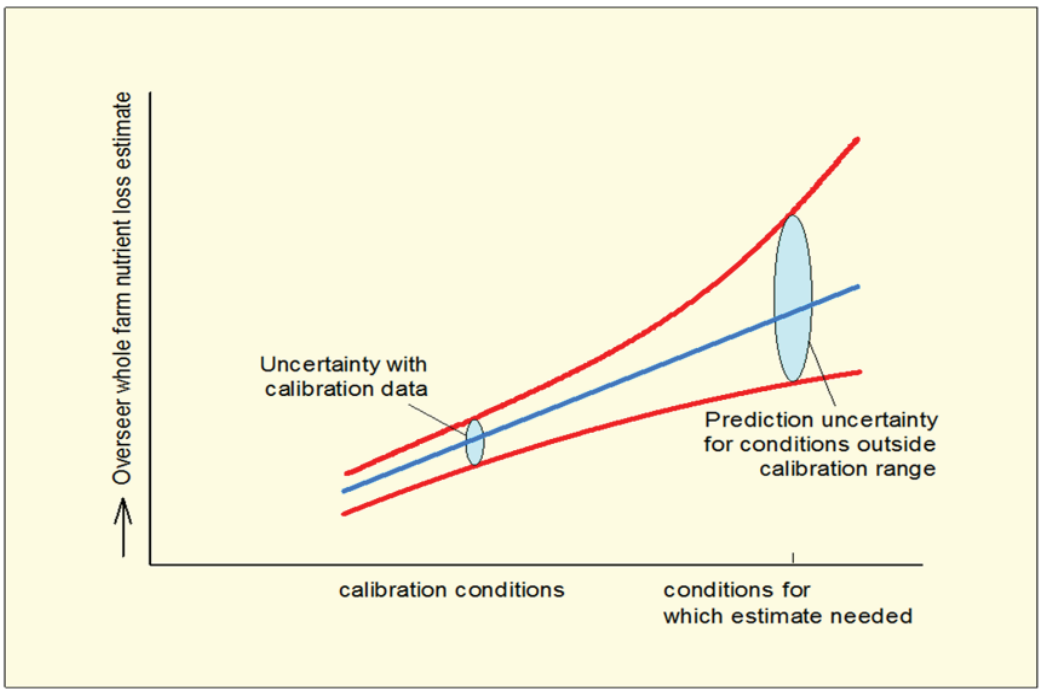
- Be as specific as possible on the quantum of the N limit(s)
- Be enforceable
- Ensure that catchment N targets based on the farm-scale N limits will be met.

All computer models are abstractions or estimations of reality and Overseer is no exception. The uncertainty of Overseer N loss predictions are due to many factors, including:

- Inherent variability in natural systems combined with complex and variable farm systems
- Limited field trial data for model calibration and validation, with many farm scenarios occurring outside the range of calibration/validation data
- Difficulty of measuring N flows in field experiments
- The sensitivity of model outputs to multiple input choices, particularly due to different user expertise and/or familiarity with local conditions and farm systems (Shepherd et al 2013).

The principle of model calibration uncertainty, as applied to the Overseer model, is illustrated in Figure 2.

Figure 2: Model Uncertainty (from David Wheeler's presentation to the project workshop, Nov. 2013)



There is no specific level of uncertainty or "error" associated with Overseer estimates of N loss. The increasing use of Overseer within RMA rules has highlighted this issue. For example, AgResearch's David Wheeler evidence for the Tukituki Board of Inquiry hearing stated:

> "There has been no uncertainty analysis undertaken for Overseer... In a study using an earlier version of Overseer, Ledgard and Waller[18] estimated that the prediction error for predicted N leaching losses for pastoral systems where there is validation data was about 25-30%, and this estimate has been widely quoted since then."

Despite this level of prediction uncertainty, the consensus of the project workshop and Tukituki land and water conferencing of experts (both November 2013) was that Overseer was the best available tool to predict nutrient losses at the farm scale. The challenge is therefore to ensure that any Overseer-based rule incorporates methods than reduce prediction uncertainty, including:

Multi-year rolling averages: Farm management decisions will vary annually, potentially exacerbating N loss prediction uncertainty. The expert consensus (project workshop and Tukituki BOI) is that for pastoral farms, an average N loss taken across three consecutive years is appropriate, with seven years for cropping systems due to the greater variability across crop rotations. However, cropping is largely limited in the Rotorua catchment to stock fodder crops within a pastoral farm system. Therefore the following recommendation is made:

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

Consistent inputs: A recent major initiative to address this is the publication of "Overseer Best Practice Data Input Standards" (Overseer Management Services Ltd 2013). This will help achieve consistency between expert users of Overseer such that there is "only one current nutrient budget per property".

Trained and certified users: Massey University offers intermediate and advanced certificates in sustainable nutrient management (SNM) which feature Overseer. However, the certificates do not provide assurance that the user is proficient in using Overseer. Therefore the Overseer owners have established a "Nutrient Management Adviser Certification Programme" – see http://www.nmacertification.org.nz/site/nutrient_management/. It is anticipated that this certification regime will form a key qualification and professional development pathway for fertiliser company field staff, agricultural consultants and Council nutrient management staff who use Overseer regularly. Although it will take some time to fully roll out the certification programme, this is arguably comparable to the time for a Lake Rotorua catchment NDA rule to become operative.

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

Local calibration / validation trials: The variability of farm systems and physical factors means it is not feasible to field test all permutations i.e. a pragmatic balance must be struck between the cost of field trials and using sound science principles to extend predictive capability outside the calibration / validation data set. The Rotorua catchment is wetter and more dominated by free-draining pumice soils compared with most sites used for Overseer calibration / validation, attributes Rotorua shares to some extent with other central North Island areas facing possible N loss constraints. BoPRC is discussing the scope, benefits and costs of a local Rotorua field trial suitable for Overseer calibration /validation purposes. In addition, the local dairy SFF project (SFF 11-023) based on Parekarangi Trust farm is two-thirds through a field trial measuring N losses under different N fertiliser regimes. Funding for this project was recently extended to allow a full three years of data collection.

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.

Linkages with catchment modelling: The NDAs being developed for farms in the Rotorua catchment are derived in part from the ROTAN catchment modelling work by NIWA. In particular, the 270 tN reduction needed from pastoral land is based on ROTAN. The calibration of ROTAN and N losses from current land uses included various N loss rates derived from Overseer version 5.4, amongst many other data sources (notably stream N concentrations and flows). The impact of using higher version 6 N loss values/assumptions is uncertain but is being discussed between BOPRC and NIWA (as at February 2014). The migration of Rule 11 benchmark data and outputs from version 5 to 6 is scheduled for February to April 2014, with the results to be considered by NIWA and BOPRC. The key message is that there are feedbacks between catchment and farm-scale nutrient modelling, and therefore the following recommendation is made:

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.

Database management: NDA rules are complex and will require long-term data storage, updates and ready access by landowners, their consultants and regional council compliance staff. Farm data and outputs will be impacted by Overseer version changes, farm system changes and mitigations. Any incentive fund purchases and farm N trading will also need to have appropriate access to be assured that real N reductions are occurring. Farmers are understandably cautious about third-party access to their farm data.

Many existing and proposed regional rules put the onus on the landowner to maintain records, including various combinations of Overseer inputs (e.g. parameter reports), outputs and the actual Overseer files. Different plans impose different obligations in terms of what information must be submitted or made available to regional councils. Little regulatory attention has been paid to the consequences of farm sales and land subdivision which further complicate Overseer and farm data management.

The challenge of efficient ongoing Overseer database management is one that must be faced by all regional councils using Overseer in their nutrient rules. Similar challenges also apply to industry EMS in terms of verification and updating EMS documentation, even without a regulatory framework. This growing data pressure is consistent with general trends for farm system management to become more data rich for productivity optimisation reasons. The growth of precision agriculture is part of that trend.

The need to implement the NPS for Freshwater Management, particularly as catchment nutrient load limits are converted to property nutrient loss limits, will lead to an exponential growth in nutrient data generation, storage and access requirements. The need for a coherent national database was made strongly by participants in the project workshop in November 2013. Therefore the following recommendation is made:

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.

Use the latest version available and compare historic/current/future scenarios with the same version: This has been canvassed in Section 4.1 above. It is logical that the incorporation of new science will improve predictive capability over time. Similarly, the comparisons and compliance checks based on the same version

will reduce prediction uncertainty by eliminating one source of variability (different model versions). The use of the latest version is already covered by Recommendation 1.

4.4 Rule linkages to Farm Nutrient Plans

Farm nutrient plans and other related types of farm plans are a common feature of regulatory and non-regulatory methods used by regional councils and industry bodies to improve farm environmental performance. There are many farm plan definitions which can cause confusion. This report has used the term "farm nutrient plan".

Traditionally farm nutrient plans have promoted "good management practices", including practices related to N loss. Such plans have increasingly incorporated Overseer nutrient budgets with quantified N loss rates. If a plan specified a target level of N loss (i.e. NDA), it may be just one element of a more holistic approach that may encompass: erosion and sediment loss; phosphorus; microbial contamination; soil health; biodiversity enhancement; energy efficiency; water use; greenhouse gas emissions; animal welfare; farm succession planning; financial and social goals. Farm nutrient plans may form part of industry Environmental Management Systems (EMS), including:

- DairyNZ's Sustainable Milk Plan (SMP)
- Beef & Lamb's Land and Environment Plan (LEP)
- NZ Deer Farmers' Landcare Manual.

Alternatively, a farm nutrient plan may focus largely on one nutrient, driven by the predominant limiting nutrient in the receiving water. Hence the proposed Tukituki Plan Change 6 has a phosphorus management plan[5] while the Lake Taupo variation established on nitrogen losses. Given the comparable nitrogen focus, the Waikato Regional Council definition of a Nitrogen Management Plan (NMP) is helpful:

> Nitrogen Management Plan - a plan that is required to continue farming which details how your farming practices meet your property's NDA. This can be the data and management practices of your highest leaching year if you want to continue your existing operations or it can be a new set of data which alters your onsite farming practices but does not exceed your NDA.

The value of a farm nutrient plan, whether standalone or part of a wider EMS, is that it can provide a practical implementation method to achieve a farm N loss target. It also enables the farmer to make day-to-day management decisions in the knowledge of the likely impact on N loss and compliance as it is not practical to re-run Overseer for every farm decision.

Other regional plans seeking to manage nutrient loss have typically required that a farm nutrient plan (or equivalent terminology) should be one or more of the following:

- Prepared in accordance with stated criteria, notably the Fertiliser Association of New Zealand's (formerly The New Zealand Fertiliser Manufacturers' Research Association) Code of Practice for Nutrient Management (2007), and/or a schedule of minimum content
- Made available or submitted to Council as part of a resource consent application, permitted criteria and/or ongoing compliance requirement

[5] The single nutrient P focus versus dual N and P focus is subject to debate within and outside the Tukituki hearing as at January 2014 – e.g. see link to EDS release.

- Updated at specified intervals or triggers e.g. significant changes in farm management that impact nutrient loss

A key issue discussed at the project workshop was the appropriate emphasis to place on compliance with a farm nutrient plan, relative to NDA compliance. While the relative compliance weighting issue was not resolved, there was clear consensus that such plans formed a key tool for both farmers and Council compliance staff that was complementary to Overseer-based quantitative limits. Given the multi-year variation of farm systems, seasonal factors and costs/prices, workshop participants considered it unreasonable to plan for a period greater than five years ahead. This necessarily limits the use of farm nutrient plans against the longer-term N limits that must be met by 2032.

While managing phosphorus is not a focus of this report, it is agreed at the project workshop that farm plans are an appropriate method to encourage the adoption of practices that reduce P losses. In particular, the identification and mitigation of "critical source areas" (CSAs) requires spatial analytical and management tools such as farm plans. The fertiliser companies are actively developing spatial mapping tools to assist farmers reduce CSA P losses e.g. the 'MitAgator' GIS-based decision support tool being developed by Ballance Agri-Nutrients and AgResearch (link).

Based on the farm management plan discussion above, the following recommendations are made:

Recommendation 8: Require that farm nutrient management plans be prepared to 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.

Recommendation 9: Develop in collaboration with industry bodies:

(i) the relevant minimum farm plan criteria
(ii) protocols on compliance with farm 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 plans.

The impact of recommendations 9 and 10 will become clearer as draft farm nutrient management plan criteria are developed and tested with farmers and industry representatives on actual Rotorua farms.

4.5 Is Overseer fit for purpose?

The consensus view from the expert workshop held in November 2013 was that Overseer is indeed fit for the purpose of regulating nitrogen loss from farms. This view expressed in conjunction with an acknowledgement that there was no practical alternative to Overseer, in that:

- Physical measurement of N loss was cost prohibitive, unrealistic, subject to its own measurement uncertainties and unable to inform "what-if" decision making, and;
- Overseer has been consciously developed as a common nutrient budgeting platform that covers all major New Zealand farm systems by using readily available input data, in contrast with other system-specific models and research-orientated models.

The reasons that Overseer is fit for the purpose of regulating nitrogen loss from farms include:

(i) Overseer provides an estimate of long-term quasi-equilibrium nutrient loss, consistent with the long-term catchment nutrient load objectives applicable to Lake Rotorua and other catchments.

(ii) Overseer incorporates the best available science on nutrient loss in New Zealand, and is regularly updated to reflect new science.

(iii) The Overseer owners have established a governance and research framework that gives confidence to regulators that the model will continue to endure and improve. This framework includes the development of supportive institution-based programmes, notably:

- The Code of Practice for Nutrient Management (2007)
- The Fertmark and Spreadmark quality assurance schemes
- Overseer Best Practice Data Input Standards (2013).
- Industry training through the Massey University intermediate and advanced certificates in sustainable nutrient management
- The Nutrient Management Adviser Certification Programme for quality assurance and professional development purposes.

(iv) Most regional councils have adopted Overseer as a key regulatory tool to manage N loss, albeit in varying ways

(v) Regulatory usage of Overseer has been endorsed by the Environment Court in deciding appeals on Waikato Regional Council's Taupo variation (RPV5) and in Horizon's Proposed One Plan (POP), with the key POP Overseer provisions also being endorsed in the subsequent High Court appeal.

Notwithstanding the clear rationale above for using Overseer to regulate farm N loss, there are significant corollary arguments and limitations to consider, including:

(vi) The rules and their implementation must deal effectively and fairly with changing Overseer outputs arising from version updates, and model uncertainty, as per Recommendations 1-7 in this report.

(vii) Overseer-based rules need to be supported by other methods, notably farm nutrient management plans and one-to-one interaction between farmers and Council staff. In fact, it is apparent that several regional plans have adopted farm nutrient management plans as the primary regulatory tool with such plans supported by Overseer nutrient budgets.

(viii) Predictions of P loss within Overseer are less certain than N loss predictions and subject to more variable off-farm attenuation i.e. at this stage it is not recommended to use Overseer to regulate P loss from farms.

(ix) Other nutrient models may prove satisfactory for regulating N loss and other regional plans have made provision for this. This "multiple model" approach was also a factor in the High Court's finding that the POP's referencing of Overseer did not need to specify a single version.

(x) Despite the incorporation of Overseer into several regional plan rules intended to limit nutrient loss, there has not been any publicised enforcement action based on those rules – or at least no cases before the Environment Court. The lack of enforcement case law means that BOPRC and other regional councils cannot be sure how non-compliance with N limits will be handled, including the challenges around Overseer versions and uncertainty.

(xi) The compliance practices developed by the Waikato Regional Council for the Lake Taupo catchment provide some useful guidance, including:

- Focus on compliance with the farm nutrient plan provisions, especially the key management factors that drive N loss such as stocking rate, stock mix, wintering practices, fertiliser and feed usage etc.
- Encourage good farm record keeping.
- Prioritise compliance effort on relative risk i.e. some farms will have larger gaps between current N loss and NDA levels.
- A tiered monitoring regime can be based on the landowner's compliance track record, similar to how several regional councils prioritise dairy shed effluent monitoring e.g frequency of site assessments.
- Apply the typical enforcement response hierarchy, relative to the specific circumstances of each non-compliance issue i.e. a range of responses from advice, directive letters, formal warnings, abatement notices, infringement fines and prosecutions.
- Maintain effective communication with farmers and their farm advisors.

Considering all the factors above, and the lessons from the project workshop and literature review, the following recommendations and conclusion are made:

Recommendation 10: Allow nutrient budget models other than Overseer to be used subject to satisfactory performance and approval by BOPRC senior management.

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

NB: The balance of this report comprises three appendices:

- Appendix A: Regional plan review
- Appendix B: Literature review of Overseer-related documents
- Appendix C: Overseer workshop summary

Appendix A: Regional plan review

Overseer is referred to in several regional plans. For this report, plans were reviewed for how Overseer was used, focusing on:

- The type of nitrogen rule limits being applied via Overseer
- Overseer version management
- Accuracy i.e. consideration of input and model uncertainty and any measures to address these
- Overseer data management i.e. input data requirements, data storage, updates
- Linkages with other tools e.g. farm and nutrient management plans.

Regional plans were reviewed for Waikato, Bay of Plenty, Hawkes Bay, Horizons, Canterbury, Otago and Southland. There are presented below in a "north to south" order.

Plan and Status	Type of N rule and N limit	Overseer version	Accuracy	Data control	Links to other tools/methods
Waikato Regional Plan (non-Taupo) **Status:** Operative September 2007. Rule 3.9.4.11 Permitted Activity Rule – Fertiliser Application, link	There are no specific N rules other than for dairy effluent irrigation to land. Separately, the permitted use of fertiliser (outside the Lake Taupo Catchment) requires a nutrient management plan where the N fertiliser rate exceeds 60kgN/ha/year.	Not specified. Arguably not relevant as the rule trigger is the N fertiliser application rate and there is no quantitative limit it on N loss.	Indirectly implied as alternatives to Overseer (and SPASMO) must be able to predict nutrient losses "...with a margin of error no more than 30%" (advisory note to Rule 3.9.4.11).	Nutrient management plans / contents must be provided to Council upon request. Basic minimum record requirements are listed (Table 3-10).	Overseer and SPASMO are treated as comparable models, with both effectively integrated within nutrient management plan requirements. The plan refers separately to the Code of Practice for Fertiliser Use.
Waikato Regional Plan Lake Taupo Catchment, Chapter 3.10 **Status:** Operative as of July 2011.	"High" N loss farming is subject to grand-parented N cap (NDA) based on the highest annual N loss in the 2001-2005 period, as a controlled activity, with a common expiry date of 31 July 2036. "Low" N loss farming is permitted up to 8kgN/ha/yr as determined by	Overseer version 5.4.3 is specified in Rule 3.10.5.3. WRC has separately negotiated ongoing version maintenance support from	No reference.	Comprehensive benchmarking information must be provided to Council, corresponding to most Overseer data inputs. Nutrient Management Plans (NMPs) are an	Policy 8d allows **alternative models** to Overseer if they can demonstrate comparable robustness. Method 3.10.4.5 outlines a guideline on NDA trading, including **how**

Plan and Status	Type of N rule and N limit	Overseer version	Accuracy	Data control	Links to other tools/methods
link (as above) Rules 3.10.5.1-3.10.5.12	a table (3.10.5.1) of stocking rate limits. N trading (offsetting) is a controlled activity provided there is no net increase in N loss.	AgResearch.		integral part of the NDA rule structure i.e. NMPs must demonstrate compliance with the NDA and NMPs must be provided to "...Council within 10 working days of farm management practices being altered"	**Overseer is used in trading** (clause c). Method 3.10.4.11 supports education, advice and extension, including via Certified Nutrient Management advisers (clause a) and periodic meetings between farmers and Overseer providers "...to discuss their nutrient management planning needs and for the providers to discuss proposed amendments to the model" (clause g).
Bay of Plenty Regional Water and Land Plan Section 9.4 **Status:** Operative October 2005, link	Grand-parented N and P cap based on the average annual N and P loss in the 2001-2004 period, for 5 lake catchments (Rotorua, Rotoiti, Rotoehu, Okareka, Okaro). Most farms are a permitted activity under Rule 11(c). N trading is a controlled activity (Rule 11(d)) provided there is no net increase in N loss – this rule has not been used.	Not specified. In fact, there is no reference at all to Overseer or the NPLAS model which was initially intended for benchmarking. In practice, the ongoing benchmarking process generally uses the latest version.	Advisory note 8 to Rule 11(c) states: "A 10% statistical variation exists in the current nutrient models". The subsequent explanation refers to losses +/-10% (relative to the benchmark) being allowed.	A series of tables (notably Table 40) specify farm information that must be provided to Council to enable staff to prepare a nutrient benchmark using Overseer. In contrast, the Rotorua catchment dairy farmers negotiated a separate process allowing them to retain individual Overseer files.	The plan sets water quality targets for the 12 Rotorua lakes and sets out a process for developing non-statutory catchment action plans (method 41). The plan has several non-statutory methods that can reduce nutrient loss e.g. riparian retirement / stock exclusion; environmental programmes (potentially a farm plan). Linkages to

Plan and Status	Type of N rule and N limit	Overseer version	Accuracy	Data control	Links to other tools/methods
					Rule 11 are limited to Table 40 data e.g. specify % riparian area fenced/retired.
Hawkes Bay Regional Plan, Change 6 Tukituki Catchment, link **Status:** Proposed, BOI Hearings completed January 2014 and decision pending.	N benchmarking is required for farms over 4ha but there is not a "hard" limit (cap) as catchment modelling indicates receiving water N load "headroom". Nutrient budgets are required by 2018 (sector specific defaults if <15kgN/ha/yr) and is permitted (Rule TT1) unless N loss increases by 10% or 5kgN/ha/yr whereby Rule TT2 applies i.e. a land use consent (restricted discretionary) and Farm Environmental Management Plan (FEMP) is required. "Industry good practice N leaching rates" will be subject to a future plan change, anticipated to be 2018. Additionally, TT2 can be triggered (after 2018) where farm N loss causes exceedances of specified river and groundwater nitrate thresholds. This complex trigger is subject to a "procedural guideline" due by 2018.	Latest. The glossary and a footnote to Policy TT4 states: "If a new version of Overseer is released then any nitrogen leaching rates previously calculated with the superseded version must be recalculated using the new version and the same input data as was used previously." There is no version reference in the rule itself.	Overseer accuracy is partly accounted for where increased N loss triggers resource consent: 10% dairy, hort & crop; 30% sheep & beef. Pastoral and horticultural systems can use 3 year rolling averages with cropping (and mixed systems) 7 years.	Properties >4ha must keep specified records from June 2013 so that enable nutrient budgets to calculated, or keep copies of input/output files from Overseer (or other industry programme approved by HBRC). The initial nutrient budgets must be provided to HBRC and three-yearly updates upon request. HBRC will treat farm records as confidential.	Alternative nutrient budget models may be approved by HBRC, provided it is "fit for purpose for the production land use, have a demonstrable repeatability of results, be field tested, and be validated to accepted scientific standards." Farm Environmental Management Plans are required in some circumstances, notably Phosphorus Management Plans in certain catchments.

Plan and Status	Type of N rule and N limit	Overseer version	Accuracy	Data control	Links to other tools/methods
	Low intensity farms (defined as <8 SU/ha) have a 10ha area threshold.				
Horizons One Plan Chapter 13 **Status:** Complex – some parts have legal effect while some await consent orders (post High Court decision Sept. 2013), link Chapter 13 as amended by Environment Court decisions, dated 20 December 2013.	LUC-based N leaching limits are defined within Table 13.2 with increasing stringency over a 20 year timeframe. The "main" controlled activity rule 13-1 applies to dairy, irrigated sheep/beef and horticulture across mapped priority catchments.	No version is specified and this approach was upheld in the 2013 High Court decision. Table 13.2 N limits were initially established and assessed with Version 5 (and sub-versions). The N limits are more difficult to meet under Version 6 assessments, leading to more farms defaulting to the restricted discretionary consent category.	No reference. The accuracy of Overseer was debated during Court hearings but this did not lead to amended plan wording.	A nutrient management plan (NMP) must be provided annually to Council. The NMP must include Overseer input and output files, or an approved alternative nutrient model.	Alternatives to Overseer may be used for the horticulture and cropping sector. Overseer is integrated within a NMP context, with NMPs to comply with the 2007 Nutrient Management Code of Practice.
Canterbury Natural Resources Regional Plan Chapter 4: Water Quality link **Status:** Operative June 2011	Rule WQL20 sets nitrate concentration thresholds based on Overseer: 8-16mg/l is permitted provided best practise are implemented; >16mg/l triggers restricted discretionary consent status.	Most recent version to be used	No reference	An Overseer calculation shall be prepared annually and records maintained for 10 years.	Overseer users shall be suitably qualified. Investigations of non-point source discharges (Method WQL10 (b)) includes "the effectiveness of nutrient management tools for farm nutrient budgeting..."

Plan and Status	Type of N rule and N limit	Overseer version	Accuracy	Data control	Links to other tools/methods
Hurunui Waiau Regional Plan, link **Status:** Operative Dec. 2013	N (and P) benchmarking using Overseer (or equivalent) is required but not as a "hard" cap. Rule 10.1 permits N (and P) discharge provided a management plan is in place, annual Overseer assessments are submitted to Council and specified in-stream nitrate-N levels are not exceeded. More permitted stringent conditions apply in Rule 10.2 in land use change" situations, triggered by >10% increase in N or P loss.	Not specified.	No reference	Overseer N and P loss rates must be provided, plus the broader detail associated with (farm) Environmental Management Strategies.	Environmental Management Strategies must include an inventory of N loss rates calculated by Overseer (or an approved alternative model). Other policies (irrigation-related) promote Audited Self- Management (ASM) and may link to Overseer assessments during implementation.
Canterbury Land and Water Regional Plan, link **Status:** Proposed, Hearings recommendations accepted Dec. 2013, notified Jan 2014.	N benchmarking (July 2009 to June 2013, aka "N baseline") combined with an N loss thresholds across 4 water quality zones: Lake, Red (~poor), Orange (at risk) and Green/Light Blue (OK or unclassified). All farming is permitted until 1/1/2017 when zone rules apply. For the large "over-allocated" Red Zone, from 1/1/2017 any increase above the N baseline is prohibited, with consents and farm plans required for N loss over 20 kgN/ha/yr (<20kgN/ha/yr remains permitted). A summary rules factsheet is here and a related FAQ here.	Latest version to be used for both the baseline and current loss i.e. "as Overseer improves the same versions are used to calculate the baseline and the subsequent rolling average." This issue is covered in an Overseer factsheet here.	No reference but the use of rolling averages is referenced in non-statutory guidance, albeit without specifying how many years.	The landowner is responsible for maintaining records of the 2009-2013 N baseline data i.e. Overseer input data. The FEP, which includes an Overseer nutrient budget "must be prepared". Although not explicitly stated, the resource consent matters of control and discretion seem likely to include submission of the FEP. Also, permitted activity conditions in the	Farm Environment Plans (FEPs) have a central role in LWRP "as as a primary means of identifying and delivering good environmental practice across a range of farm activities, including nutrient loss management...". FEPs are defined in Schedule 7 (link), with nutrient management one of six objectives to be met. FEPs must be prepared by an FEP "Auditor" who is defined as someone with at least 5 years professional experience

Plan and Status	Type of N rule and N limit	Overseer version	Accuracy	Data control	Links to other tools/methods
				Orange and Green/Light Blue zones state information is to be recorded "and supplied to CRC upon request".	and either of the Massey SNM certificates or other suitable qualification approved by Ecan's CEO.
Otago Regional Water Plan Change 6A (Water Quality) link **Status**: Proposed, Council Decisions Version April 2013	Numeric N leaching limits. Rule 12.C.1.3 permits N leaching (discharge) to groundwater from April 2020 up to limits of 10, 20 and 30 kgN/ha/yr depending on the relevant Nitrogen Sensitive Zone – these are mapped. Discharges above these N limits default to restricted discretionary status, amended from prohibited status in the notified plan version. The N limits are total N, not just nitrate.	Version 6.0 NB: this is the only specific version reference other than WRC's Taupo rules. ORC's decision report states that it is an RMA requirement (Schedule 1, Part 3) to specify the version, with updates via plan change only.	No reference	Landowners must maintain records from May 2014 i.e. input data for Overseer 6.0. Such data must be provided to Council on request OR the Overseer output and input parameter reports "prepared by an accredited Overseer 6.0 user".	Chapter 15 briefly notes ORC's support of codes of practice and EMS to reduce adverse effects on water resources but this is not linked to Rules (e.g. 12.C.1.3)
Regional Water Plan for Southland link, **Status:** Operative 2010, with New Dairy Conversions Rule 17A Proposed April 2012.	No specific N rules except a dairy effluent limit of 150kgN/ha/yr (unrelated to Overseer) in Rule 50 which is controlled, restricted discretionary or non-complying depending on soil type and contamination risk. More significantly, new dairy conversions required a full discretionary consent from April 2012 under "transitional" Rule 17A (also referred to as Rule 16C in	Not specified.	No reference. The issue was raised in Ngai Tahu's submission with concern that Overseer was not calibrated for Southland soils and climate.	Nutrient management plans must be submitted with resource consent applications. Consent conditions can require that such plans be kept up to date and submitted to Council on request.	A farm management plan integrates a "winter grazing plan" and a "nutrient management plan". The latter must incorporate a "nutrient budget developed by an accredited nutrient advisor using Overseer or similar..." Broader guidance is provided via best practice

Plan and Status	Type of N rule and N limit	Overseer version	Accuracy	Data control	Links to other tools/methods
	some ES plan documents). A rule 17A Q&A is here. Several have been publicly notified with the most recent example subject to a staff s42A report recommendation to decline on the basis of more than minor adverse effects from increased N loss on a nearby stream - see link.				guidance, including a nutrient management factsheet (here) that references Overseer. The farm environment plan template is here.

Appendix B: Literature review of Overseer-related documents

This literature review focused on documents that addressed the four main "Overseer questions" used in the expert panel workshop and throughout this report i.e.

- Version
- Accuracy
- Integration with farm plans
- Overall fit-for-purpose

The review mainly considers documents published since 2010 to reduce historic references to Overseer that are "interesting" but less up-to-date.

Note on Tukituki Board of Inquiry Documents

There is a particular focus in this literature review on expert evidence associated with the 2013 Tukituki Catchment Board of Inquiry (BOI) process as it is the most recent RMA forum where key Overseer questions have been openly examined. The BOI anticipates releasing a draft decision in April 2014 with a final report and decision due by 28 May 2014. Given the legal and technical expertise within the Board, submitters and staff, this BOI decision may be influential in how Overseer is used in Lake Rotorua catchment rules.

AgResearch (2006): A simple sensitivity analysis of nitrogen leaching for three Taupo farming systems, estimated using the Overseer nutrient budget model. Client report prepared for Environment Waikato by Ian Power, Amanda Judge and Stewart Ledgard; 26pp, link.

Summary: Analysis of varying key Overseer inputs within three contrasting Lake Taupo catchment farms, identifying high, medium and low impact variables in terms of N loss prediction. Version 5.2.6 was used.

The 8 high impact variables were: N fertiliser applied; winter N fertiliser; stocking rate; winter grazing management (dairy); stock records (drystock); rainfall; pasture development; clover content. The first 5 of these are dependent on good records, as were many medium and low impact variables. For some other variables, AgResearch recommended using default values such as "developed" pasture status for all farms, particularly in view of the long time horizons for catchment action and groundwater/lake response.

AgResearch (2013): OVERSEER®: Answers to commonly asked questions. Client report number: RE500/2012/027 link

Summary: The Overseer model is briefly described with questions and responses grouped into: How the model works and its strengths and weaknesses; Model uncertainty; Model performance for different sectors; Policy development and application issues.

This report provides an up to date summary of likely stakeholder and regulator concerns, including the degree to which they are addressed within the Overseer model or which must be considered when the model is used in RMA rules. It is emphasised that "*Overseer* is an expert user system and the outputs are dependent on many inputs that rely on expert judgement."

AgResearch (2012-2014): OVERSEER® Technical Manual, Prepared by D M Wheeler and M A Shepherd, presented in various sections via this link.

Summary: The Overseer model is described in 9 downloadable sections with an additional section on the Animal Model pending. Each section explains how the main Overseer sub-models work, the main assumptions and sources of data. The Introduction section (November 2013) provides a useful overview for the non-expert reader, covering descriptions of the model's history, governance, capabilities and assumptions, plus the farm systems, inputs and mitigations that can be modelled.

Conference of experts (2013): As part of the Tukituki Plan Change 6 – Land and Water Quality Conferencing 21 October 2013. Present: David Wheeler, Ants Roberts, Alec Mackay, Andrew Macfarlane, Chris Lewis, Ian Milner, Tony Rhodes, Nathan Heath, Rich McDowell, Alison Dewes, Phyllis Tichinin, Phil Schofield, David McCall, Claire Mulcock. http://www.epa.govt.nz/Publications/Joint%20Witness%20Statement%20-%20Water%20Quality%20-%20managing%20farming%20activities%20within%20limits%20and%20targets.pdf

A concise summary of Overseer's use in PC6, including consensus on:

- Pan-sector input standards for Overseer users
- Consent conditions to "incorporate a mechanism for using the latest version of Overseer, including a provision for back-casting using earlier inputs"
- "Overseer is the best tool that we have available to predict nutrient losses at the farm scale

There was divided opinion on addressing irrigation options within Overseer based not on the adequacy but whether it was possible to direct the Overseer owners to make changes deemed (by some) to be necessary.

Dewes A (2013): Statement of Evidence before the Board of Inquiry into the Tukituki Catchment Proposal, on behalf of the Hawke's Bay Fish and Game Council, 63pp, link.

Summary: The Overseer nutrient model is a world-class model and is subject to various limitations that need to be addressed within the policy and rule. Plans should provide for complementary measures such as farm plans that identify critical source areas which are generally not accounted for in Overseer.

Environment Court (2008): Interim Decision on Proposed Variation 5 to the Waikato Regional Plan (RPV5), Court Reference No. A123/2008, 74pp, link.

Summary: A set of interim decisions and reasons on multiple points of appeals on RPV5.

Key decision points included:

- N leaching rates for pines could be fixed at 2 kgN/ha/yr despite evidence that there could be extended higher N loss upon pine establishment on pastoral soils as soil N mineralised and leached. The same N limit was set for land in gorse and broom despite evidence of higher N loss rates to avoid a perverse windfall reward for poor land management.
- Controlled activity consent status for N loss from farms is appropriate - permitted rules would be too complex and hard to enforce. 25 year consent terms were appropriate. The default rule status is non-complying.

- The rules can be framed either as s9 land use rules or s15 discharge rules.
- Nutrient trading between farms via NDAs is appropriate.
- Overseer, as a long-term equilibrium model based on sound science, is fit for setting and monitoring NDAs.

Note that the related final 2011 Environment Court decision consists simply of the agreed RPV5 plan text, much derived from witness caucusing following the Court's interim 2008 decision. However, the key Overseer questions were addressed in the 2008 interim decision.

Hawkes Bay Regional Council (2012): Nutrient management approaches for the Tukituki catchment. Report prepared by Monique Benson, Larissa Coubrough, Ian Millner and Rob van Voorthuysen, 40pp, link.

Summary: A review of how different regional councils and industry bodies manage nutrient loss from farms, covering current and proposed RMA plans as well as industry-led good practice initiatives and nutrient management within irrigation schemes. This review is used to inform the anticipated nutrient management framework for the Ruataniwha Water Storage Scheme (RWSS) and the associated RMA plan change.

The wide use of Overseer in both regulatory and non-regulatory contexts is summarised alongside the inter-related tools like nutrient management plans and audited self-management (ASM). The use of Plant and Food's SPASMO nutrient model within the RWSS catchment modelling work was not inconsistent with HBRC's anticipated regulatory use of Overseer. Nitrogen allocation methods are compared and a natural capital approach is preferred, while noting the Tukituki catchment is under-allocated for nitrogen.

High Court (2013): Decision on Proposed One Plan for the Manawatu-Wanganui Regional Council, Court Reference [2013] NZHC 2492, 56pp (no web version available).

Summary: A set of appeals on points of law were resolved in terms of the 2012 Proposed One Plan (POP) decisions made by the Environment Court.

Key decision points included:

- The broad planning regime determined by the Environment Court was upheld, being similar to the original POP as notified, but more restrictive than the Hearings Panel version.
- It was appropriate to regulate all forms of intensive farming in nutrient sensitive catchments, not just dairy. Further, extensive sheep and beef farming should be incorporated into the same regime eventually by way of a plan change due to the aggregate N load from large areas of drystock farming, albeit at lower N loss levels per hectare.
- The LUC-based NDA allocation method with a series of N loss "step-downs" was appropriate, not the "reasonably practicable farming practices" approach adopted in the Hearings Panel POP version.
- The generic reference to using Overseer without specifying a version was upheld i.e. the relevant POP wording did not contravene RMA Schedule 1 Clauses 30-35 regarding the incorporation of documents and methods into plans by reference. Part of the High Court's logic was that the principle reference to Overseer is via the definition of "nutrient management plan" whose adequacy is determined in accordance with the 2007 Nutrient Management Code of Practice. Further, nutrient budget models other than Overseer may be used, thus emphasising the validity of the generic reference to Overseer (i.e. without a specific Overseer version number).

- There was mutual acknowledgement of the difficulties arising from the LUC-linked N limits (Table 13.3, POP) being based on Overseer Version 5.4, given the typically higher N loss levels being generated by Version 6 for the same farm i.e. the version upgrade makes compliance much more difficult. While this issue was deemed outside the High Court's jurisdiction, Council and Federated Farmers have the option of resolving it in the Environment Court if a s294 RMA application is made (i.e. new important evidence has become available that would impact the decision).

Fertiliser Association of New Zealand (2013): Nutrient Management Adviser Certification Programme, web page and associated documentation, link.

Summary: An outline of the new certification programme (NMACP) to ensure that not only have Overseer users passed the Massey University certificate courses (link) but that users maintain continuous professional development (CPD) and are regular users of Overseer – see this link for the CPD policy for Certified Nutrient Management Advisers.

Millner I (2013): Statement of Evidence before the Board of Inquiry into the Tukituki Catchment Proposal, 33pp, link.

Summary: Phosphorus targets can be met through Phosphorus Management Plans (a type of spatial farm plan) complemented by a nutrient budget. For nitrogen management, a three yearly nutrient budget cycle is appropriate. Pastoral farms (and permanent horticulture) warrants a three year benchmarking period with arable farming and cropping needing a seven year period to reflect year-to-year system variability. The HBRC plan should retain the ability to adopt nutrient budget models other than *Overseer* provided they are: fit for purpose; show demonstrable repeatability of results; be field tested and validated to acceptable scientific standards.

Mulcock C (2013): Statement of Evidence before the Board of Inquiry into the Tukituki Catchment Proposal, 161pp, link.

Summary: Evidence on behalf of the Ruataniwha Water Storage Scheme developers (HBRIC) giving an overview of the Irrigation Environmental Management Plan (IEMP) and the individual Farm Environmental Management Plans (FEMP).

Key points include: Audited self-management (ASM) has a key role to play within the regulatory framework but that flexibility is needed on the types of ASM programmes and FEMPs allowed, subject to alternative FEMPs being certified by Council. A key feature of ASM is "continuous improvement" with feedback loops to enable adaptive management, reflecting the inherent uncertainty in our knowledge of complex dynamic natural systems. The process for updating and recertification of IEMP/FEMP must be clear in the Plan.

The core FEMP content is set out, including: Management objectives and required outcomes for the components of the farming systems that have an impact on water; Practices / Actions / Records / Timelines for improvements; An appropriate nutrient budget, as this is a key tool for understanding nutrient cycling on farm and managing nutrient loss.

The auditing of FEMPs is critical and must cover “assessments of performance against the management objectives and targets, as well as actions; the overall robustness of the management programme to manage identified risks; the level of confidence in the nutrient budget results...”

Overseer Management Services Ltd (2013): Overseer Best Practice Data Input Standards, 64pp, link.

Summary: The Standards are to assist expert users to define data inputs into OVERSEER® that consistently achieve the most accurate nutrient budget of a farm for nutrient management purposes. They are not intended to teach users how to operate OVERSEER®.

Key points: “User selection of the input parameters can have a major affect on the estimates of nutrient cycling for the described farm systems and hence the ultimate budget reports. The purpose of providing a ‘best practice’ Standard is to reduce inconsistencies between different users when operating OVERSEER® to model individual farm systems... The standards were developed by a group of technical experts from a wide range of organisations and a wider stakeholder group were consulted during the development of the standards.”

Quality Planning (2014): External documents and appendices, accessed February 2014, link.

Summary: Clause 30(1) of Schedule 1 RMA identifies the type of documents that can be “incorporated by reference” within a RMA plan. Clause 31 requires that a variation or plan change take place before an “amendment to an externally referenced document to have effect through the plan”. Computer models are not considered in this brief QP advice note.

Roberts A (2012): Brief of Evidence before the Hurunui Waiau Regional Plan Hearing, 19pp, link.

Summary: A review of the Overseer model, its strengths and limitations, mitigation options and the consequences of new versions.

Key points include: Overseer estimates N loss at the end of the root zone and knowledge is needed on attenuation rates (and water quality N limits) before setting on-farm N limits. Previous Overseer versions notes that the error in drainage water N estimates was +/-30% and while it was not known if Overseer 6 had similar error, this was comparable to field measurement variability. Overseer must be used by properly trained persons with good local farm system knowledge.

New versions of Overseer will give different N losses for the same input parameters; with major implications for meeting N limits based on previous Overseer versions e.g. One Plan N loss compliance difficulties under Version 6. Research into DCD mitigation showed late summer /early autumn urine deposition contributed to winter N loss – this lead to changes in DCD application guidelines and reduced effectiveness for winter-off grazing mitigation in Overseer 6. As Overseer is a long-run equilibrium model, it should be used to assess N loss over multiple years, not within or between years.

Shepherd M, Wheeler D, Selbie D, Buckthought L and Freeman M R (2013): OVERSEER®: Accuracy, precision, error and uncertainty. Accurate and efficient use of nutrients on farms. (Eds L.D. Currie and C L. Christensen). http://flrc.massey.ac.nz/publications.html. Occasional Report No. 26. Fertilizer and Lime Research Centre, Massey University, Palmerston North, New Zealand, 8pp, link.

Summary: An explanation of four terms – accuracy, precision, error and uncertainty – used to describe the performance of models such as Overseer in estimating whole-farm nutrient losses.

Key points include: It is not usually practicable to directly measure whole-farm nutrient losses, use of the terms accuracy or error are not directly applicable, because there is no true value to compare an estimate with; Model uncertainty is the most relevant term and will be greatest for conditions where there are no, or few, data for calibration and validation. Precision is about precision of Overseer input information and can be partly addressed through users following the recently published Overseer Best Practice Data Input Standards (2013).

Van Voorthuysen R (2013): Statement of Evidence before the Board of Inquiry into the Tukituki Catchment Proposal, updated 25 November 2013, 133pp, link.

Summary: A comprehensive review of Tukituki BOI submitter evidence and, where supported by the author and/or expert conferencing, a set of amended nutrient policies and rules, notably amended Rules TT1 and TT2.

Key elements from this updated evidence have been incorporated in the HBRC section of the RMA Plan review table within this report. Until a Plan "decisions" document is released by the BOI, this appears to be the most relevant up-to-date text. In terms of the important Overseer version issue, the following is stated: "If a new version of Overseer is released then any nitrogen leaching rates previously calculated with the superseded version must be recalculated using the new version and the same input data as was used previously."

Wheeler D (2013): Statement of Evidence before the Board of Inquiry into the Tukituki Catchment Proposal, 25pp. http://www.epa.govt.nz/resource-management/NSP000028/NSP000028_15%20David%20Wheeler%20-%20Evidence.pdf

Summary: A description of work undertaken for the Ruataniwha Water Storage Scheme (RWSS), particularly Overseer modelling of land use scenarios and recommendations for the use of Overseer.

Much of the evidence is directly relevant to the Lake Rotorua catchment, including the following quotes taken from Section 2, Summary and Conclusions:

> *"Overseer* has been developed to cover a wide range of farm management systems…"
>
> *"Overseer* assumes that a number of 'good management practices' are applied, especially for storage and application of effluent, fertiliser, and irrigation."
>
> "A study using an earlier version of *Overseer*, estimated that the prediction error for predicted nitrogen (N) leaching losses for pastoral systems where there is validation data was about 25-30%. A similar prediction error is likely to apply to N leaching losses in the current version of *Overseer* (version 6.0)."
>
> *"Overseer* is currently the only tool available for predicting nutrient losses from a wide range of farm management systems."
>
> "The multiple roles of *Overseer* mean that upgrades are likely to continue for purposes other than its use in the regulatory environment. The results from *Overseer* analysis are expected to change over time, and some of the changes in output values may be significant, especially for situations outside of the calibration data range. This obviously needs to be considered should *Overseer* be used in a policy implementation context. I recommend the following:

(a) Caution should be exercised about specifying a specific *Overseer* version number in a policy;

(b) A process for updating any baseline, thresholds, targets or limits when a new version of the model is published should be considered;

(c) Wherever possible, use should be made of *Overseer* to assess relative changes, rather than absolute values;

(d) For monitoring purposes, if annual data inputs are used, I recommend the use of a rolling average or trend analysis to reduce the effect of year-to-year variability…"

The full evidence statement provides useful direction for potential Rotorua catchment RMA rules.

Appendix C: Workshop Summary

The workshop summary was circulated to workshop participants and invitees on 5 December 2013. Feedback was invited and has been incorporated into the main report and recommendations.

Workshop Agenda

- Context – Simon Park
- Rule 11 and Overseer – Penny MacCormick
- Local policy context – Sarah Omundsen, Lisa Power
- Overseer history, governance and development – Greg Sneath
- Overseer science, uncertainty and version issues – David Wheeler
- A farmer perspective – Stuart Morrison
- 1st Workshop session: What are the key Overseer questions for Rotorua?
- 2nd Workshop session: Answering the key Overseer-RMA questions

Workshop Objective

To provide advice to BOPRC on the regulatory use of the Overseer model to control farm nutrient losses in the Lake Rotorua catchment, consistent with the proposed RPS and recent BOPRC decisions, by drawing on comparable NZ experiences, literature and expert advice.

Key Overseer-RMA questions

Four key questions were pre-circulated to help focus workshop discussion, as follows:

1. Will Overseer estimates of NDA be "good enough" in terms compliance, N purchase (incentives) and N trading (between farmers)?
2. How should a NDA rule account for Overseer version changes?
3. How should Overseer uncertainty be accounted for in the NDA rules?
4. How should farm nutrient management plans be linked to Overseer and the NDA rules?

Structure of this workshop report

The workshop was structured into three parts: (i) scene setting presentations; (ii) identifying the key questions; (iii) answering the key questions. This report is structured as follows:

- A summary of each presentation, with full pdf versions appended.
- Consideration of the four key questions in turn, with each question having a numbered summary of discussion points and a boxed list of key messages. As there was broad consensus that the four pre-circulated "key questions" were the most relevant, discussion from sessions (ii) and (iii) has been merged.
- A series of appendices covering: (1) workshop attendees; (2) secondary questions; (3) pre-circulated material and; (4) workshop presentations.

Please note that this summary report captures a mix of consensus and individual views. The workshop invitees will be asked for further input to this draft workshop report.

Workshop outline presentation – Simon Park, Headway Ltd

There is keen interest in the workshop topic from regional councils, industry and central government. This reflected the common challenges facing councils and farmers on how to sustainably manage farms and catchments within limits. Introductions were made and workshop protocol was outlined.

For most presentations summarised below, the full slideshow is appended to this report.

Rule 11 presentation – Penny MacCormick, BOPRC

BOPRC was the first regional council to regulate diffuse nutrient loss from land at the catchment scale, with five lake catchments being covered by "Rule 11" since October 2005. Therefore the current NDA rule development represents a second generation of nutrient rules, at least for the Lake Rotorua catchment.

Rule 11 is a grand-parenting rule, capping N and P loss to 2001-2004 levels through an Overseer-based benchmarking process. Although the rule applies to properties over 0.4ha, the focus has been on properties over 40ha for logistical reasons. There have been multiple challenges, including:

- Accurately defining the surface catchment boundary where Rule 11 applies
- A false start with the "NPLAS" model before Overseer was adopted
- Overseer version updates
- Obtaining adequate reliable Overseer inputs and consistent input protocols e.g. soils
- Data access and storage
- Resistance from farmers
- Limited staff and contractor resourcing

Despite the challenges, Rule 11 appears to have worked as an interim nutrient capping rule. It has helped lead to a wide acceptance that nutrient rules are needed, preparing the ground for new rules.

Policy context presentation – Sarah Omundsen, BOPRC

The policy context is driven by the new Regional Policy Statement, (RPS) the wider Rotorua lakes programme and the collaborative policy process that BOPRC was embarked on with local stakeholders. The key policy context includes:

- The RPS sets a Lake Rotorua sustainable annual nitrogen load of 435 tN by 2032, with 70% of the necessary reduction to be met by 2022. Broad allocation principles are in the RPS.
- The 10 Year Plan provides for a $45.5m nutrient reduction plan – subject to Crown approval
- A 270 tN reduction is needed from pastoral land to meet the 435 tN target
- A Stakeholder Advisory Group (StAG), including local farmers, has been established to provide policy advice in nitrogen allocation and rules
- StAG's initial position paper was adopted by BOPRC in September 2013 – key aspects are summarised in the table below (as presented):

Rules programme – 140 tonne reduction		
By 2015	Farm nutrient plans	Plans will be put in place for every farm, setting out a practical pathway of staged nutrient reductions
By 2017	Resource consents	Farms will be consented, with nutrient reduction plans as a consent condition
By 2032	Nitrogen Discharge Allowances	Proposed average of 35 kgN/ha for dairy and 13 kgN/ha for drystock, with adjustments made for geophysical and farm system characteristics

Incentives programme – 100 tonne reduction		
Now to 2022	Incentives fund	$40m "below the line" to remove 100 tonnes of N $5.5m "above the line" to get to the NDAs
Gorse programme – 30 tonne reduction		
Now to 2022	Gorse fund	Separate funding to remove 30 tonnes of N from gorse

- A controlled activity NDA rule is envisaged to cover most commercial farm N loss scenarios
- There is a lot of associated technical and policy work underway.

Overseer presentation – Greg Sneath, Fertiliser Association

Greg's presentation covered Overseer's history, ownership structure, future development and industry support programmes – some key points:

- History – evolution from fertiliser recommendation models, addition of environmental capabilities such as effluent, GHGs and P runoff, through to major Version 6 upgrade
- Be clear on both:
    - what Overseer does i.e. models nutrient cycling and losses leaving the farm
    - what Overseer does not do i.e. environmental impacts.
- Joint ownership: MPI, Fertiliser Association of NZ and AgResearch
- New governance and management structure (see appended presentation diagram)
- Ongoing Overseer development, including S-map integration
- Overseer is part of a wider industry response to the RMA – consider Fertmark and Spreadmark schemes, Code of Practice, industry training (Massey courses and fertiliser company internal programmes) and information booklets
- Nutrient management advisor certification with:
    - enduring governance and advisory group structures
    - qualifications, assessments and continuing professional development
- A definition: Industry best practice = certified nutrient management advisors using Overseer best practice data input standards

Overseer presentation – David Wheeler, AgResearch

David outlined Overseer's design and science principles, including (from appended presentation):

- **Development objectives:** provide a tool that 'fairly and equitably' captures farm management systems across New Zealand by
    - Capturing paths of nutrient transfers within a farm system
    - Using a robust science process to capture the fate of nutrients at each transfer point
- so that outputs are farm-specific with the constraint of:
    - Using data that the farmer knows, is readily available, or suitable defaults are available
- **The model is still under development** with new science (e.g. CSA), management systems (e.g. pigs) and new data (e.g. S-map), therefore:
    - Results will change over time!
- **Version numbering:** first digit major change; 2nd digit minor change; 3rd digit maintenance fix
- **Model uncertainty:** be aware of uncertainty within and outside calibration conditions
- **Uncertainty can be reduced by:**
    - Standards, verifiable data, training, accreditation, …

- Peer review of science
- Testing the model extrapolation – targeting epistemic uncertainty
- Improved understanding of system model operates within
- Learning to live with it: Feedback mechanisms; Risk management

A farmer perspective – Stuart Morrison, dairy farmer

Stuart Morrison has farmed in Oturoa Road for "several" decades and highlighted several points:

- Farmers face major costs to reduce N loss, potentially up to $130m, less incentives ($45.5m)
- Farm viability is crucial to farmers and the local economy
- Concern about model uncertainty, complexity and compliance costs / constraints – who pays?
- The lake is now at its target TLI, probably due to alum dosing – we need more explanation
- Industry support through this policy process is important and appreciated – DairyNZ has been involved from early on
- There is farmer support for the extended timeframe to 2032, the collaborative process with StAG and the overall framework – as usual, the devil will be in the detail.
- Need to strike the right balance between certainty and flexibility i.e. adaptive management

Will Overseer estimates of NDA be "good enough" in terms compliance, N purchase (incentives) and N trading (between farmers)?

1. Yes - Overseer is "good enough" and has been effectively endorsed as "fit for purpose" in Environment and High Court decision on the Lake Taupo Variation 5 and Horizon's One Plan.
    a. Rephrase the question as: "Will using Overseer help to meet the Lake Rotorua target?"
2. There is no current alternative that covers a broad ranges of farm systems with the necessary institutional processes and resources to update the underpinning science, user interface and system coverage, noting:
    a. The regulatory use of Overseer is outside its original purpose, and (largely) outside current funding arrangements.
    b. Overseer enables an output focus (N loss) which , being effects-focused, is much better than specifying inputs such as stocking rate, N fertiliser use etc. However, an inputs focus may have some scope for small scale permitted activities.
3. Rules should still allow other models to be added later, if suitable models are developed e.g. industry/crop specific models.

Key messages

- Overseer is fit for the envisaged regulatory purpose provided all the other questions raised in this workshop are addressed, particularly:
    - care with rule framing to deal with model uncertainty and version changes
    - robust implementation support systems are established and maintained
- The limitations of Overseer must be acknowledged alongside recognition that there is no current alternative capable of estimated nutrient loss across diverse farm systems
- Allow for other nutrient models to be used e.g. specialist crop-specific models

How should a NDA rule account for Overseer version changes?

4. Assessment of the differences between NDA levels and monitoring (actual/current N loss) must use the same version of Overseer – comparing apples with apples – noting:
    a. This means re-running a new version of Overseer with the farm's "original" input data, then comparing with current farm status or future mitigated scenarios. However:
        i. The "original" input data is logical if the rule is a grandparent rule i.e. a set of actual farm inputs at a specific date (or averaged over a specific period)
        ii. For a non-grandparented NDA as envisaged for Rotorua, would input data need to be synthesised for each farm to generate the allocated NDA (i.e. to allow the input data be re-run with future Overseer versions and NDA adjusted accordingly)?
        iii. Or could NDA adjustment be done at a catchment scale? For example, if Version 6 increases dairy N loss by an average of 20% across the catchment relative to Version 5, then does the dairy NDA 35 adjusts by 20% to 42 kgN/ha/yr, with corresponding future adjustments as new versions are released. More consideration is needed as the draft NDAs are not based directly on Overseer. The NDAs are derived from allocating the sustainable load across current areas of dairy and drystock land in the catchment.
    b. Access to original or base year input data is important i.e. robust information protocols and effective database access are needed, especially given farmer sensitivity on commercially sensitive farm system data. Taupo NDAs are public but all other information is confidential to farmer and Council.
    c. Robust IT systems, maintenance and funding needs to be established.
5. Clarity is needed on what "version change" means as there are three tiers denoted by the three digit version reference i.e. an explicit version protocol needs to be defined in RMA rules.
6. Overseer version 5.x.x results were broadly similar, compared with a step change/increase in version 6 (20% plus), at least for Rotorua soils/rainfall.
7. Fixing a version number in the rules is a trade-off between "RMA certainty" and gradual obsolescence as science and new features are added, noting:
    a. Farmers and Council typically <u>want</u> to see the introduction within Overseer of new mitigations and new farm systems. This will be particularly important in the Rotorua catchment given the large reductions needed.
    b. Multiple Councils/plans locking in different specific versions would require AgResearch to maintain multiple versions (at a cost) and make consistent expert Overseer use more difficult.
    c. A nationally consistent approach across all regional councils is highly desirable.
8. Consider the implications of version changes relative to fixed numeric NDA levels e.g. the shift from version 5 to 6 switched most farms needing One Plan resource consent from "controlled activity" to "restricted discretionary" status, with accompanying farmer uncertainty.
9. Overseer-driven NDA can and should be complemented by other tools to make the regulation more robust e.g. a risk-based score card.
10. As noted above, it is preferable for the required NDA to be amended with each (major?) version change, noting:
    a. The RMA challenge where a numeric NDA level is specified within consent conditions.
    b. Consideration should be given to a proportionate share NDA, analogous to the ITQ system used in NZ quota-managed fisheries. To explain:
        i. If the total pastoral NDA allocation across the catchment is 356 tN (because 100 tN is subject to incentives), this can be distributed across 100,000 ITQ shares
        ii. A farm that would have an NDA = 3560 kgN gets 1000 ITQ shares (1% of total)

iii. Although attractive in theory, this poses major challenges in terms of perception and the RMA legislative framework
iv. Overseer-based NDA assessments would still underpin a farm ITQ
v. More analysis of ITQ concept is needed...

c. Farmers will be wary of changing NDA numbers and perceive unfairness.
d. While it is possible to devise rules that will maintain "apples with apples" comparisons between NDA and actual N loss, and at an overall catchment level, it is likely that relativity between farms will still change e.g. version 6 gave relatively higher N loss in higher rainfall zones, compared with version 5 outputs.

11. The different options for addressing Overseer version changes within rules, and associated strengths and weaknesses, are summarised in the table below[6]. Please note that some table elements have been added after the workshop.

Table of Overseer versioning options, strengths and weaknesses

Version Option	Strengths	Weaknesses
1. **Specify a version in the rule**	• Certainty for farmers and Council • Relativity between NDA and actual NL maintained	• Becomes obsolete by not adopting latest science, farm systems and mitigations • Requires separate contract and funding to maintain version usability • Out of step with all other uses and users of Overseer
2. Specify that the latest version is always used	• Always up to date • Latest mitigations and farm systems included • Consistency amongst expert users	• Maintaining relativity between NDA and actual NL requires the NDA to be recalculated* with each update. Alternatively, relativity is lost to varying degrees. • Perception risk with "frequent" changes • Bugs can cause anomalies until fixed
3. Specify a version time window e.g. every 5 years	• Some option 2 strengths • Recalculation of NDA (or difference between NDA and NL) can be anticipated	• Partly obsolete and out of step with other RCs before updates occur • Requires Overseer owner and expert support to maintain version usability • Arbitrary anniversary date may "capture" a version with bugs
4. Specify major updates only e.g. 6.x.x until 7.x.x is available	• Some 2 & 3 strengths • Recalculation of NDA can be anticipated with Overseer owner support	• Requires Overseer owner cooperation on planning update release timing • Variable loss of relativity with "minor" updates between major updates
5. Modified Fisheries ITQ (individual transferable quota)**	• Shifts focus partly away from Overseer • Fair as each farm target is a constant share of total catchment allocation target	• More analysis needed! • Complex, novel, new analysis needed • RMA amendment needed? • Overseer updates still needed behind ITQ

[6] An expanded version of this table is Table 1 within the main report

*Recalculation of NDA – this concept needs clarification. It basically relies on using a consistent set of input parameters (defined for each farm) every time Overseer is updated.

Key messages

- Imposing property-specific numeric NDA values will lead to regulatory difficulties when different Overseer versions give different N losses (NL) for the same input parameters.
- Relativity between historic, current and target N loss (= NDA) can be maintained by running all scenarios in the same version of Overseer – the challenge is how to do this.
- Successful version change implementation will depend on ongoing industry and expert support and robust IT systems to manage input/output data with integrity
- Farmers need to see that the versioning system adopted is fair and transparent – this will be especially challenging when "numbers change"

How should Overseer uncertainty be accounted for in the NDA rules?

12. Uncertainty must be explicitly addressed in the rules and not left for later "implementation".
13. Uncertainty in Overseer needs to be considered alongside uncertainty at the catchment scale i.e. catchment and lake modelling. Although the 435 tN sustainable load is driven by lake science, there may be future issues around N attenuation and lag times en route to the lake.
14. Overseer's uncertainty is both positive and negative so the predicted output is the middle of the possible range. Whilst a claim to be at one end of the uncertainty range is plausible, it is equally plausible for the same farm system to be at the other end of the uncertainty range i.e. the 'middle' prediction is the most reasonable.
    a. Providing a NDA range that reflects Overseer uncertainty will erode catchment reduction targets as farms inevitably shift to the upper end of any allowable range.
15. Physical measurement of N loss is costly/impractical and subject to significant error as well.
16. Uncertainty challenges within rules can be reduced by:
    a. Using a N loss rolling average – 3 years is adequate for dairy but there are challenges for dry stock i.e. stock mix/system can change quickly in response to market prices.
    b. Shifting the NDA regulatory emphasis to proportionate reduction, broad magnitude and the direction of change, with consequently less focus on small NDA changes and associated non-compliance
    c. Consistency in using Overseer inputs is vital given multiple users within and outside Council. The pending Overseer input standard/protocol is important and should be followed by all users.
    d. Local validation trials will help, enabling Overseer tweaks (if necessary), noting:
        i. Local trials to address multiple permutations of soil, rainfall and farm system are cost prohibitive
        ii. Overseer uses sound science principles to extrapolate beyond its calibration/validation data sets
        iii. A pragmatic balance must be struck between affordable validation and extrapolation within the model using sound scientific principles.

Key messages

- Uncertainty will always be with us – acknowledge this upfront – and be clear on what type of uncertainty is being addressed
- Input protocols/standards and S-map functionality will improve (reduce) input uncertainty
- Model uncertainty may be reduced over time, and by local validation trials
- Rolling multi-year averages are best when in checking compliance against a property NDA
- A compliance range would tempt all farms to operate at the upper end of a range
- Shift the focus to "moving in the right direction" and the practical farm management methods to achieve this – see farm management plans!

How should farm nutrient management plans be linked to Overseer and NDA rules?

NB: the discussion below covered monitoring and compliance issues beyond farm plans.

17. Compliance with the NDA (including progress requirements towards the NDA) and the farm nutrient plan (FNP) is complementary, noting:
    a. Good nutrient practices evolve, so a flexible FNP is important
    b. FNPs need to be updated regularly and efficiently i.e. consent conditions must enable this with minimal bureaucracy.
    c. FNP/NDA compliance needs to be simple i.e. easy for both farmer and Council officer.
    d. Monitoring is resource hungry.
18. Taupo system - if the farmer wishes to intensify beyond key input parameters, the nutrient budget and associated FNP needs to be redone i.e. Overseer only re-run if inputs change significantly, noting:
    a. Taupo WRC staff have only dealt with monitoring to date, not compliance/enforcement
19. Most Overseer and farm planning expertise and resources sit outside regional councils i.e. with farm consultants, fertiliser reps and industry good field staff.
20. FNP templates/requirements must be consistent with industry initiatives and other catchment/Council requirements, as consultants and industry reps should be able to use the same or similar tools across different catchments, noting:
    a. National level coordination is vital – MPI, MfE and the Fertiliser Association are all interested in this space
    b. Alignment is needed between Overseer block set-up and the land management units (LMUs) prevalent in some farm plan templates
    c. While Rotorua is N-focused, we need to recognise farm plan templates are generally much more holistic, covering P, sediment, pathogens, animal welfare, biodiversity, energy, water use and a range of farmer-identified goals.
21. Effective farmer-Council engagement and mutual trust as important as the NDA itself.
22. Monitoring every two years, supported by random auditing (analogous to IRD) works in Taupo.

Key messages

- Farm management plans are key to enabling farmer compliance on a practical basis
- Industry support is vital for advising on and implementing farm plans
- Holistic plans must be allowed i.e. broader than N management

- Consistency across industry and council plan templates is desirable – minimum criteria / content must be defined in the plan (e.g. alignment with Overseer block set up), along with provisions for updating plan content

A regular monitoring and audit regime is needed

Appendices

1. **Workshop attendees**
2. **Secondary questions**
3. **Draft rules and incentives framework**

Appendix 1: Workshop Attendees

Name	Affiliation
Greg Sneath, Caroline Read	Fertiliser Association of NZ
Gavin Forrest	MPI
Sara Jellie	MfE
Stuart Morrison	Dairy farmer, former StAG chair
Ian Power	Ballance Agri-Nutrients Ltd
Ollie Parsons	DairyNZ
Charlotte Rutherford, Richard Allen	Fonterra
Erica van Reenen	Beef & Lamb NZ
Lee Matheson	Perrin Ag Ltd
Alison Dewes	Headlands Ltd
Rob van Voorthuysen	Van Voorthuysen Environmental Ltd
Justine Young, Jon Palmer	Waikato Regional Council
Clare Barton	Horizons
David Wheeler	AgR Overseer team
Penny MacCormick, Sarah Omundsen (project manager), Lisa Power, Gloria Zamora	BOPRC
Simon Park	Headway Ltd, BOPRC project contractor

Appendix 2: Secondary questions

These secondary questions are important and several may be linked to the key four questions canvassed at the 15 November workshop. The secondary questions (numbered 5-12) were circulated prior to the workshop along with other supporting documentation.

5. What resource consent term and/or review period is desirable due to Overseer version changes?
6. A rule hierarchy is envisaged using area and/or N discharge thresholds. How does Overseer's features and limitations impact any such rule hierarchy? For example, is there are place for Overseer-based look up tables (e.g. stocking rates) for small property / permitted activities?
7. Will a NDA allocation range (e.g. 30-40 kgN/ha/yr for dairy land) be workable given Overseer uncertainty, relative to a single NDA value (e.g. 35 kgN/ha/yr for dairy land)?

8. NDA leasing appears desirable but what RMA mechanism(s) can be used?
9. How should monitoring, audit and enforcement account for Overseer's features and limitations?
10. What rolling average period is appropriate to determine compliance with a property NDA, and is it the same for dairy and drystock land?
11. Should NDA rules be linked to evolving "good management practices" and if so, how?
12. How can industry Overseer expertise/resources/systems be accommodated within rules? For example, how should Overseer user certification be specified within rules?

Appendix 3: Draft rules and incentives framework

There are several documents covering the draft rules and incentives framework for Lake Rotorua:

- See http://www.rotorualakes.co.nz/rotorua_rules_incentives for Council and StAG policy.
- There is a helpful FAQ section at http://www.rotorualakes.co.nz/vdb/document/500.
- The attached workshop presentation by Sarah Omundsen.

It is important to note that the catchment sustainable annual nitrogen target has recently been set at "435 tN by 2032" within operative parts of the Regional Policy Statement. This represents a 320 tN reduction from "current" levels (estimated by ROTAN), with a pastoral sector reduction of 270 tN. The rules and incentives package aims to achieve that N reduction by 2032, in terms of N discharge to land. Groundwater lags means it will take longer to meet the 435 tN target as N load to the lake.

The rules and incentives package focuses strongly on nitrogen. The science consensus (via the Lakes Technical Advisory Group) is that Lake Rotorua is N and P co-limited. It is anticipated that P can be controlled by in-lake actions (e.g. alum dosing) and/or by catchment P reductions associated with (or complementary to) N reductions. Therefore pastoral N reductions are the key policy focus.