Corner Ruakura
& Morrinsville Roads
[withheld]

Proposed amendments to the National Policy Statement for Freshwater Management: A discussion document

4 February 2014

Submission by DairyNZ

1 Executive Summary

1 DairyNZ is grateful for the opportunity to comment on *Proposed Amendments to the National Policy Statement for Freshwater Management 2011: A discussion document.* The proposed amendments move the package of national freshwater policy forward considerably and provide a much clearer pathway to implementation. Setting limits for freshwater quality and quantity is a complex task. We consider that a robust National Objectives Framework (NOF) in particular will be critical to delivering the freshwater outcomes desired by all New Zealanders.

2 Given the extensive nature of the proposed amendments to the National Policy Statement on Freshwater Management (NPSFM) we have prepared our submission in three parts:

1. Policy-focused issues
2. National freshwater values
3. Technical issues in relation to the NOF.

We hope this approach is helpful to those considering our submissions.

3 In regard to policy-focused issues, DairyNZ is seeking that the Government:

- Schedule a review of NPSFM and NOF implementation by the Office of the Auditor General prior to the proposed NOF amendments in 2016.
- Provide a detailed guide to interpretation and implementation for stakeholders.
- Establish assessment criteria for National Bottom Lines.

- Clarify definitions of water management zones and artificial water bodies.
- Ensure management is driven by freshwater objectives, rather than attributes.
- Strengthen requirements for community engagement and investigating feasibility.
- Ensure exceptions to National Bottom Lines are minimised.
- Develop an agreed, representative and nationally standardised approach to environmental monitoring and reporting.
- Direct regional councils to seek synergies with industry in providing freshwater accounting systems, to reduce costs and potential redundancy.

4 In regard to freshwater values, DairyNZ is seeking that the Government:

- Retain secondary contact recreation and ecosystem health as the national compulsory values.
- Include pressures from introduced species in ecosystem health.
- Retain fishing as an optional, rather than compulsory value.
- Broaden the explanation of the value of food production.
- Retain contact recreation as an optional, rather than compulsory value.
- Reinstate the cleaning, dilution and disposal of wastes as a value.

5 In regard to the freshwater attribute tables, DairyNZ is seeking that the Government:

- Require a robust and standardised sampling methodology.
- Include the Macroinvertebrate Community Index.
- Provide a more robust national bottom line for periphyton as an indicator of ecosystem health.
- Align lake attributes with international practice.
- Investigate the cost and feasibility of achieving the proposed standards for all shallow lakes.
- Require a more stringent measure of safety for *E. coli* impacts on secondary contact recreation.
- Retain planktonic cyanobacteria as an attribute for secondary contact recreation.
- Retain the exclusion of benthic cyanobacteria.

2 Introduction

6 DairyNZ is grateful for the opportunity to comment on *Proposed Amendments to the National Policy Statement for Freshwater Management 2011: A discussion document*. We are supportive of the vast majority of the proposed amendments. In particular, we believe the introduction of a National Objectives Framework (NOF) provides a unique opportunity for more focused and transparent decision-making on freshwater management, as well as a basis for more robust, science-based debates on freshwater issues.

7 DairyNZ is the industry good organisation representing New Zealand's dairy farmers. Funded by a levy on milksolids and through government investment, our purpose is to secure and enhance the profitability, sustainability and competitiveness of New Zealand dairy farming. We deliver value to farmers through leadership, influencing, investing, partnering with other organisations and through our own strategic capability. Our work includes research and development to create practical on-farm tools, leading on-farm adoption of best practice farming, promoting careers in dairying and advocating for farmers with central and regional government. For more information, visit www.dairynz.co.nz.

8 DairyNZ strongly supports policy that is founded on robust science. We believe that taking an evidence-based approach leads to more effective and enduring policy, with fewer negative outcomes. Our policy positions are based on economics, farm systems and water quality expertise. In our submissions on both regional and national government policy, we seek to ensure that the focus remains on addressing real rather than perceived issues.

9 This submission has been prepared by the DairyNZ policy team, incorporating expert technical reviews conducted by:

[withheld]

10 We have consulted with other representatives of the primary sector. The primary contact for this submission is:

[withheld]

3 General Submissions

11 DairyNZ recognises the value of a more consistent approach to implementing the NPSFM. We believe the NOF is an essential part of the freshwater management framework and that the vast majority of proposed amendments are vital. By providing councils and communities with a consistent framework, the Government has the opportunity to significantly reduce transaction costs and to provide greater certainty that environmental, economic, social and cultural outcomes for freshwater management can be met.

12 The introduction of national bottom lines will provide us for the first time with a shared understanding of what "poor" looks like at a national level. By implementing a framework based on scientific consensus, limit-setting at the community level can more appropriately focus on the balance of freshwater values that are to be provided for, rather than debating the science.

13 Court appeals are not the best process for getting robust assessment of complex technical issues. We already have far too few experts, whose time could be better spent benefitting their fields of knowledge. We expect the NOF will enable freshwater science to be more focused on understanding and finding solutions to problems, rather than adversarial entanglements in planning processes. While currently incomplete, we understand the NOF will be populated in the coming years through further collaboration and agreement among the country's top scientists.

14 DairyNZ's investment in environmental programmes is approximately $11 million per year. Through their levy, New Zealand's dairy farmers are investing in scientific research in next generation farm systems and improving our understanding of how to address the impacts of land use on water quality. They are also investing in social research in how to support better community engagement in freshwater management processes. Additionally, farmers are investing in research to explore the economic impacts of limit setting on both farm profitability and the impacts for local and regional economies.

15 The dairy industry is ready to take up the challenge of achieving community-determined freshwater objectives and their associated limits and bottom lines. Through the Sustainable Dairying: Water Accord, the industry has made a series of commitments that will improve water quality, as well as provide robust accounting systems to assist resource managers in decision-making.

3.1 Oversight

16 The potential benefits to New Zealand accruing from the NPSFM and associated NOF are significant, but benefits will only be realised through full implementation by regional councils. We are concerned that some regional councils may see the amended NPS as business as usual and seek to make the NPS and NOF 'fit' their existing, or planned, approaches to freshwater management. We recommend that there be explicit provision made in the NPSFM for a review of implementation of the amended NPS and NOF by the

Office of the Auditor General prior to the next round of amendments in 2016. Furthermore, we would recommend that the review seeks input from major sector groups engaged in freshwater management to provide feedback external to local government.

17 Outcome sought:

- Schedule a review of NPSFM and NOF implementation by the Office of the Auditor General prior to the proposed NOF amendments in 2016.

3.2 Further Guidance

18 We believe that the additional provisions that have been introduced for the NPSFM should be accompanied by additional guidance. In some areas, we have requested that matters be made clearer within the document itself. However, specific interpretation may still vary. There is potential for differing opinions on interpretation to result in significant costs, particularly if final views require settlement through the courts.

19 Outcome sought:

- Provide a detailed guide to interpretation and implementation for stakeholders.

3.3 Criteria for establishing National Bottom Lines

20 DairyNZ supports the development of National Bottom Lines. We have provided specific feedback on the National Bottom Lines that are currently proposed through our submissions on the attribute tables. However, we are concerned that there are not transparent, carefully-considered criteria against which National Bottom Lines can be assessed. This will be vital as the NOF is reviewed and evolves to incorporate new science. Because of this, we support the submissions of Federated Farmers of New Zealand in relation to the establishment of explicit assessment criteria.

21 Outcome sought:

- Establish assessment criteria for National Bottom Lines.

4 Section 32 Analysis

22 DairyNZ has supported previous amendments to section 32 of the Resource Management Act 1991 (RMA) in order to require more robust quantitative analysis of costs, benefits and alternatives. While the section 32 analysis is generally conscientious, we believe some aspects could be more robust. As many section 32 analyses will be required in the coming years for various limit-setting processes, we believe it is important that examples of good practice are developed, in order to provide clear guidance to regional councils on how the amended requirements of the RMA should be interpreted.

23 We are concerned at the lack of analysis undertaken on the impact of National Bottom Lines in relation to shallow lakes. As noted, monitoring data is limited (with only 108 lakes in total). We believe that further analysis is needed on the costs and feasibility of restoring all shallow lakes in New Zealand to the levels prescribed in the NOF. As noted in our submissions on the attribute states themselves, many lakes which have already undergone a regime shift effectively cannot be restored to their prior state. This is particularly true for very shallow lakes, which undergo a natural process of infill and eutrophication, eventually becoming wetlands. While acceleration of this process may not be desirable, it is important to recognise that these freshwater systems are not naturally in a steady state.

24 We were encouraged to see the inclusion of bio-economic modelling in the section 32 analysis as a means for assessing the impacts of limits. It is our view that such modelling is vital for engaging with communities about the impacts of different freshwater limits and policy options. DairyNZ is now investing over $1m per year to support the building of national capacity in this area and to help develop methodologies which have broad support among experts. Collaborative approaches to assessment of economic impact assessment are already underway in the Waikato region and elsewhere as a result of this investment. We appreciate that the document acknowledges that there are limitations to all modelling. However, we believe that some of the modelling that supported the section 32 analysis contained more specific shortcomings.

25 As alluded to in the text of the discussion document, the levels of mitigation effort and effectiveness contained within some of the modelling is likely to be overly-optimistic, resulting in under-estimation of the true costs. In our experience, it is vital to build realistic farm scenarios for mitigation by working with local farmers who understand the specific constraints of the area. It is also vital that modelling is built on a range of farm system types, as impacts tend to be highly-varied within sectors for given policy scenarios. Working from “average” farm system types results in significant effects and interactions being masked. For example, disproportionate impacts may occur for particular farm systems, or mitigation options may not be economic for others. When models are built from unrealistic assumptions, impacts can be misestimated by massive margins.

26 In addition, it is misleading to simply look at scenarios that involve managing down to bottom lines. The NPSFM requires that improvement to national bottom lines must be done

alongside maintenance or improvement of overall water quality, indicating that total costs are likely to be larger than estimated due to forgone development.

27 In our view, the comment that "…[a]gricultural employment (dairy, sheep and beef, and horticulture) is a small percentage of total employment so impacts, if any, incurred to employment will be low" is not correct. This ignores the significant indirect employment generated by agricultural industries and the large differences in regional impact that occur despite relatively small differences in environmental impact for a given scenario. Numerous studies have been undertaken showing the significant impacts of severe limits on communities. An example from the Horizons region is outlined below.

4.1.1 Case study: Cost Benefit and Economic Impact Analysis of the Horizons One Plan

Following the Environment Court decision on the Horizons One Plan, DairyNZ and Horizons Regional Council commissioned a report assessing the potential impacts of different implementation options. The analysis was undertaken by Market Economics and Nimmo-Bell and can be found at www.dairynz.co.nz.

The analysis was based on a set of representative dairy farms, capturing a full range of farm systems specific to the affected areas, as well as different biophysical limitations. The report examined the regional impacts of three different mitigation scenarios (blanket N-leaching limits, farm system change and within-system mitigation).

The difference in impact between farm system change and within-system mitigation provides vital insights into how the impacts on social and economic well-being in a region are sensitive to relatively small changes in environmental impacts between different limit-setting scenarios. Importantly, the difference in the impact of farm system change on the wider community was in fact much greater than the difference in the impact on farmers themselves. The farm system change scenario achieved nitrogen loss reductions of 23 per cent and resulted in the loss of 480 jobs and $27 million per year. The within system mitigation scenario achieved nitrogen loss reductions of 18 per cent and resulted in losses of only $1 million per year and an additional 52 jobs per year for the region.

28 In addition, looking only at the percentage of rural employment in a region ignores the asymmetrical impacts of decreased rural employment. While impacts may seem small at the regional level, the human cost may be much more severe at the community level. Many rural communities have experienced decline for some decades. The adverse impacts this has had on social well-being, physical and mental health for rural communities are well-documented. It is DairyNZ's view that the introduction of regulation with such potentially severe social impacts should not be treated lightly.

29 This being said, DairyNZ agrees that the greatest potential cost to society is the cost of not acting. As a country, we simply cannot afford to have more sunk investment that can be avoided if appropriate controls are put in place. In catchments where development pressure results in limits being reached or exceeded, mitigation costs rise exponentially for our farmers. While milk production may grow, the cost of increasingly severe environmental regulation will erode farmers' profitability (a scenario referred to as "rotting from the bottom").

Ultimately, this type of regulatory failure could put large parts of New Zealand's agricultural sector at risk. In a number of sensitive catchments around New Zealand, our dairy farmers face changes to their businesses not seen in generations, as the result of retroactive controls on land and water. The pain this creates for farming families that are affected is severe and needs to be avoided in the future.

5 Preamble and Interpretation

30 We support the amendment of the NPSFM to refer to water management units, rather than water bodies. We agree that the appropriate scale for management may vary considerably, depending on characteristics of a catchment's use (e.g. more or less developed areas), geology (e.g. where groundwater flows between surface water catchments) or key stressors (e.g. toxic point sources or cumulative effects).

31 We believe that the replacement of "water bodies" with "water management units" has created a technical issue however. While "water body" is an RMA term, a "water management unit" is something defined by a regional council. We note that there is no requirement that the set of water management units contain all the water bodies in a region. As a result of this amendment, it appears that there is no requirement for all water bodies to contribute to some sort of limit. While we recognise that some catchments will not require active management (for example, pristine catchments), this does not necessarily mean they should be excluded from the management and monitoring regime.

32 In addition, there remains some uncertainty as to how artificial or modified water bodies are to be treated under the NPSFM (for example, farm drains, irrigation canals, stock water races etc.). This is leading to disagreement about where it is appropriate to apply given values. Given the introduction of national bottom lines, this is even more critical. Uncertainty about the application of national bottom lines to artificial water bodies may result in significant cost in resolving the issue through the courts. As such, it would be advantageous for Government to take the opportunity to clarify this matter now.

33 Outcomes sought:

- Clarify whether the water management zones defined by regional councils must include all water bodies in a region.
- Define and specifically exclude artificial water bodies from the NPSFM and National Bottom Lines.

6 Objectives and Policies

6.1 Maintaining or improving water quality – Objective A2

34 It is important that freshwater objectives are focused on outcomes, rather than a narrow set of attributes, because different attributes will vary in importance depending on the water body. Not all attributes need to be maintained at a particular state to achieve the desired outcome (i.e. achievement of a specific objective). Defining "maintain or improve" poorly may serve to create perverse drivers for freshwater managers which do not result in community values being properly provided for and incur significant mitigation cost for little or no environmental benefit.

35 DairyNZ supports the retention of the requirement to maintain or improve overall freshwater quality within a region. While the National Objectives Framework gives us national bottom lines, this does not entail a licence for regulators to allow excellent water quality to become merely "good". Recent national state of the environment reporting has highlighted that overall, water quality in New Zealand is good and shows a mix of improving and deteriorating trends.

36 We believe that further guidance may be needed on what "maintain or improve" means in practice. This was identified by regional councils as an area which is particularly poorly defined. DairyNZ is concerned that some risk remains that "maintain or improve" will be defined through the courts, at considerable cost to all involved.

37 In our view, the NOF provides councils with a tool to set clear objectives for overall water quality that are linked to specific, measureable outcomes. For example, an objective might be set to increase the number of safe swimming sites, or to increase overall habitat protection for indigenous species. Achieving the desired objective should be the principal outcome measure as councils seek to "maintain or improve" overall water quality.

38 We believe that further direction is needed to ensure councils and their communities interpret the requirement to "maintaining or improve overall water quality". While the attributes that have been identified so far are important, water quality for any particular value is often a function of multiple and interacting stressors, not all of which are currently defined within the attribute tables. For example, a small unshaded stream with moderate nutrient enrichment may have excess algal growth and high temperatures during summer low flows. Reducing nutrient concentrations may address algal growth without reducing temperatures. However, appropriate riparian planting and provision of shade may serve to solve both problems with better outcomes for aquatic ecosystem health.

39 Outcome sought:

- In collaboration with regional councils and key stakeholders, clearly define "maintain or improve overall freshwater quality" to ensure achievement of objectives, rather than attributes.
- Incorporate this definition in the NPSFM.

6.2 Connections between freshwater and coastal water – Policy A1

40 DairyNZ supports the explicit consideration of the connections between fresh and coastal water. It is our understanding that this is already a requirement under the New Zealand Coastal Policy Statement. However, raising the issue highlights that the state of knowledge of coastal effects is far behind our state of knowledge on freshwater.

41 The freshwater-marine interface, particularly estuaries, needs to be a priority for investment in research. The potential costs associated with either excessively or inadequately limiting development because of uncertainty in coastal effects are significant. In some areas, rivers will easily meet water quality objectives, but may have unacceptable effects on the environment in poorly-flushed coastal areas. Many of these estuaries, embayments and lagoons are highly-complex and dynamic. Our current knowledge of what is required to meet objectives in these areas is limited.

42 Outcome sought:

- Make research into the freshwater-marine interface a priority for research investment.

6.3 Transitional provisions – Policy A4

43 DairyNZ supports provisions regarding human health having immediate effect. We believe it is essential that regional councils have the tools immediately available to ensure that any national bottom lines are not breached in the short-term while the process of limit-setting is underway. We note that a number of councils do not currently have monthly monitoring programmes for E. coli across representative sites in their region, so their ability to measure the current state is limited. We would hope that monitoring plans produced as required by Policy CB1 would address gaps in regional council monitoring for this important national value.

6.4 Freshwater quantity

44 The suite of amendments that is proposed currently is largely concerned with water quality. The national values and attributes that have been introduced are largely concerned with factors which only cover water quantity insofar as it affects dilution and water quality. The effect is that the NPSFM now has a more comprehensive set of policies in relation to water quality than quantity.

45 It is our view that further guidance on a framework for setting ecological, environmental and allocable flows is warranted, especially in relation to attributes which may affect the values that have already been included (for example, how flow regimes and riverbed habitat may impact on ecosystem health).

46 Outcomes sought:

- Undertake work to define water quantity attributes and appropriate A-D bands for the Aquatic Ecosystem Health value.
- Include flow/water level as an attribute for all four water body types in the table on page 21 of the discussion document.

6.5 National Objectives Framework

6.5.1 Community participation

47 While the importance of community views is present in the preamble, it is largely absent from policy CA1, which sets out the limit-setting process. DairyNZ considers increased community participation in how freshwater is used and managed to be a critical component of the freshwater reform agenda.

48 As a member of the Land and Water Forum, DairyNZ gained extensive experience of the value of collaboration and agreed outcomes. The NOF itself (both conceptually and in its detail) is the product of much hard work by groups representing diverse interests. We believe it can be an enduring and valuable policy instrument because of this. To give effect to the intentions of the Land and Water Forum, this collaborative approach should be carried through to implementation.

49 We understand that a new collaborative freshwater planning process is to be introduced via an amendment to the RMA. However, this remains optional. DairyNZ is concerned that past approaches may continue despite the current reform agenda, resulting in freshwater policy that does not directly reflect community values and does not have a viable pathway to implementation.

50 Under policy CA1(f)(v), regional councils must consider the implications for "actions, investments, on-going management changes and any social and economic implications" when identifying freshwater values. However, there is no policy that requires councils to have any regard as to whether these impacts will prove acceptable to a community.

51 DairyNZ considers that considerable risk remains that councils will lightly consider and disregard implications which communities consider to be of critical importance, continuing a culture of "propose and defend" in some regions. Often, policy options are consulted on without the implications being fully analysed and presented to the community. Without considerable expertise in policy, science or economics, this locks most members of the community out of the regulatory process.

52 Emerging best practice in setting freshwater limits involves working with communities to identify values and to explore the implications of a range of possible changes before the notification of a proposed plan. This involves an iterative process of setting objectives and using good science and economics to test scenarios, so that communities can make transparent decisions. In our view, this is what consideration of alternatives should mean in regard to section 32. When agreement has been reached, a robust plan can be notified. It is

our experience that where councils have consulted on a broad range of values and associated implications before proposing a plan, this has resulted in more focused submissions, hearings and appeals, as well as reduced costs.

53 Outcome sought:

- Introduce a new part to policy CA1, explicitly requiring councils to involve communities on the implications of a range of freshwater values and objectives, and to have regard to community views when setting freshwater objectives in a plan.

6.5.2 Feasibility of implementation

54 Similarly to the matter of community participation, DairyNZ considers that considerable risk remains that adequate consideration will not be given to the feasibility of implementing particular policy options. While we recognise that it is neither necessary nor desirable to develop a full implementation plan early in the limit-setting process, we consider that policies could be considerably improved by at least having regard to what a high-level implementation process would look like. This should include considering the likely resourcing requirements, engaging with organisations that are expected to be involved in implementation and re-examining policies if there is no clear pathway to implementation.

55 Outcome sought:

- Introduce a new part to policy CA1(f) explicitly requiring councils to consider how given policy options will be implemented and the feasibility of implementation.

6.6 Exceptions to national bottom lines – Policy CA2

56 DairyNZ believes that national bottom lines should be achieved wherever possible. Given that the national bottom lines should be designed to reflect what is considered unacceptable by New Zealanders, any exceptions should not be taken lightly. Because of this, we believe that clauses enabling any exceptions to national bottom lines should be read as narrowly as possible.

57 DairyNZ is supportive of Policy CA2(a), providing for exceptions due to natural conditions. We recognise that there are a number of water bodies which will fit this definition and are relatively non-controversial. One area where we believe this provision could be clearer is how it is intended to apply to biological sources of contaminants determined to be "naturally occurring". For instance, bird colonies are used as an example where exceptions to *E. coli* guidelines may be required. It would be useful to clarify whether this include effects caused by indigenous, naturalised, acclimatised or pest species. While effects caused by pest species should certainly not generate a burden on other resource users to address effects, this does not necessarily mean that the effect should not be addressed.

58 As mentioned in our comments on the section 32 analysis, we are concerned about how National Bottom Lines might apply to shallow lakes. If analysis shows that the proposed standards are not feasible, Policy CA2(a) may provide a means to exempt these water bodies. Shallow lakes undergo a natural process of infill and eutrophication, which may be accelerated by human activities in some instances but cannot be prevented. This is similar to the process of soil erosion. Regional plans tend to recognise accelerated erosion as something to be managed, but erosion itself as a natural process in a dynamic landscape. Rather than attempting to artificially impose a steady state on shallow lakes, a more appropriate approach would be to manage accelerated eutrophication. Clarification is needed on whether this would be an acceptable practice for regional councils.

59 DairyNZ is concerned that Policy CA2(b) is too broad. We understand that the policy was developed as a means to address instances where the reversal of historical effects may result in worse effects (for example, disturbing sediments contaminated due to historical mining waste). However, we believe this narrow intention has not been effectively carried through into the policy as it is worded. The term “reasonably practicable” is far too open to abuse.

60 The dairy industry has spent years developing the technologies and capacity necessary to address water quality issues in New Zealand. For example, The Code of Practice and Design Standards for Farm Dairy Effluent, the IPENZ Practice Note on effluent storage ponds, the Nutrient Management Advisor accreditation programme and the Audited Nitrogen Management system. This is in addition to our core business of improving farm system efficiency, driving increased profit from the same or lesser environmental footprint.

61 We believe that doing the right thing is important and worth doing. We do not expect it to be easy or cheap, but we are prepared to rise to the task. However, if the industry’s investment is to be justified, we expect that all sectors of society will have to meet the same outcomes. As highlighted in the section 32 analysis, breaches of some of the national bottom lines are predominantly urban. Very poor water quality in urban environments has come to be accepted as the norm by some. DairyNZ is concerned that populous areas with large numbers of ratepayers may choose to exploit clause CA2(b)(ii) where there is significant cost associated with remediating effects.

62 In order to avoid overly-liberal interpretation of “reasonably practicable”, we believe it is appropriate that freshwater management units that are exempted from national bottom lines under CA2(b)(ii) are required to be scheduled in an appendix to the NPSFM, as for exemptions under CA2(c). The scheduling of freshwater management units should be undertaken as a transparent process whereby members of the public are given the opportunity to debate, comment and submit on whether it is appropriate that an exception be made.

63 It is our understanding that Policy CA3 is intended to apply where there may be considerable lag times before actions that are taken will result in improvement in freshwater quality. For example, in some catchments, groundwater may take 20, 50 or 100 years to reach a water body, meaning that water quality may deteriorate before it improves due to historical impacts. We do not see this as necessitating exceptions to national bottom lines.

As timeframes for targets to be met have significant discretion, it is our view that it would be more appropriate to simply set a timeframe for achieving the national bottom lines that takes account of expected groundwater lags. Provided the focus is on the objective there should be no major issue if some attributes sit below the bottom line, particularly if this pattern is openly recorded.

64 More problematic than where objectives are set is the requirement for regional councils to "maintain or improve" water quality. In some cases (where historical contaminants are being released from groundwater) it may not be physically possible to maintain or improve the state of a water body in the short-term. Rather than granting exemption to national bottom lines for freshwater objectives, it would be more appropriate to detail why a specific water body might need to be excluded from a regional assessment of water quality state and trends (i.e. to address the "maintain or improve" requirement). Once historical effects have abated, monitoring can be re-included to show the results of current actions.

65 Outcomes sought:

- Ensure that "naturally occurring processes" will exclude effects caused by acclimatised or pest species.
- Clarify how "naturally occurring processes" will apply to shallow lakes.
- Require that exceptions under CA2(b)(ii) be scheduled in the NPSFM and subject to a public submission process.
- Delete CA3.
- In developing a definition for "maintain or improve" (as in paragraph 39 above), include explicit exemption for cases where there may be further deterioration of values before mitigation actions taken have effect.

6.7 Monitoring plans

66 DairyNZ supports the amendments in relation to freshwater monitoring plans. Regional councils are already doing excellent work in the field of environmental monitoring. We believe the chief strength of this amendment is in requiring that monitoring occur in relation to the achievement of freshwater objectives. Without clear context for statements about water quality, environmental reporting can be largely meaningless to the general public. We see this amendment as engaging the public in freshwater issues and trends – for example, answering questions like "how many more swimming days were there at popular sites this summer compared to last?".

67 We see value in the Government bringing together key regional council staff to develop an agreed national approach to monitoring plans. This will avoid the additional cost of each region being required to develop their own methods independently, whist also taking maximum advantage of the good practice that has been developed in many regions. This would also provide the Government with an opportunity to give clear guidance on what is meant by reporting in relation to objectives. Developing an agreed methodology will also

make national state of the environment reporting far less onerous, due to the use of standardised methods across the country.

68 We note that while CB1(b) (identifying representative sites) requires that monitoring be representative of each freshwater management unit, there is no requirement that monitoring is representative across a region, let alone across the country. This has long caused state of the environment reporting to be misleading (Snelder et al 2006[1]). Currently, there are far more monitoring stations in more developed catchments. While this may be appropriate for monitoring purposes, it means that when reporting is undertaken on a "number of sites" basis, it presents a highly-skewed picture of water quality states and trends within a region. It is our view that the public of NZ deserve unbiased reporting of water quality states and trends.

69 Outcomes sought:

- In collaboration with regional councils, develop an agreed, nationally standardised approach to environmental monitoring and reporting.
- Require that reporting be representative at the regional level.
- Undertake analysis as to the representativeness of reporting at the national level.

6.8 Accounting for water quality and quantity

70 DairyNZ is supportive of the requirements for freshwater accounting. In our view, timely and robust accounting for freshwater takes and contaminants is essential for effective management. It is extremely difficult to determine whether there is even sufficient risk to require a policy response without understanding the current and potential future impacts of various pressures on freshwater. It is important, however, that this increased focus on accounting is implemented in a way that seeks to build upon, rather than duplicate, current efforts and investment in this area.

71 Effective freshwater quality accounting is about more than just contaminants however. Water quality is affected by multiple interacting stressors in addition to contaminants (for example, shade and temperature). In order to be practical and informative, it is important that accounting frameworks focus on the most relevant stressors, as appropriate to particular water bodies.

72 The dairy industry has invested significantly in accounting frameworks. The *Sustainable Dairying: Water Accord* has a number of accounting requirements. For example, in collaboration with the fertiliser industry, DairyNZ has developed an audited nitrogen management system that will enable dairy companies to model nitrogen loss on supplier dairy farms in a robust manner, according to agreed protocols and consistent data collection systems. Dairy companies are now implementing sophisticated environmental management systems which include collecting information from every dairy farm and providing

[1] Snelder, T., Scarsbrook, M., Larned, S. (2006). Assessment of the national pool of river water quality monitoring sites using the REC. MFE06501.CHC2006-060.

benchmarking and performance information back to farmers. DairyNZ is also undertaking on-farm trials to better understand the volumes of water being used for shed wash-down and milk cooling under different seasonal and geographical conditions. When coupled with industry requirements for water meters on farm, this will support much more accurate estimation of water use under permitted activity rules.

73 Among other requirements, the dairy industry has committed to monitor and report:

- The length of stock excluded waterway/area of significant wetland and the length of any dispensations.
- The percentage of regular stock crossings that have bridges or culverts and any dispensations.
- The extent of riparian margin planted on-farm and through industry/community partnerships e.g. off-farm planting.
- The average nitrogen loss per hectare (by region and/or catchment) as modelled using Overseer.

74 We consider these measures to be a major investment in accounting for freshwater takes and potential impacts from dairy farms. Because of this, we are seeking to avoid costly duplication of effort by working with regional councils to provide robust, auditable information about resource use at catchment and regional scales. In our view, it is clear that there will be little (if any) requirement for any additional freshwater accounting for the dairy industry. We recognise that there are key research gaps for non-consented freshwater use, but we are working to address these currently.

75 Outcome sought:

- Direct regional councils to seek synergies with industry in providing accounting systems to reduce costs and potential redundancy.

7 National Values for Freshwater

7.1 Compulsory values

76 We support the introduction of human health (secondary contact recreation) as a national, compulsory value that applies to all water bodies throughout New Zealand. It is reasonable to assume that any waterway in the country could be used for wading or boating over much of the year and entirely appropriate that direction be given to regional councils on managing human health risks during those activities. There may be a limited number of situations where this value is not appropriate (e.g. downstream of riverbed-nesting bird populations), and these should be dealt with through a very tightly constrained exceptions register.

77 We do not support the call from some parties for contact recreation (swimming) to be included as a compulsory national value. Swimming is site-specific and time-specific (generally at low flows during warmer months) and human health risks are already managed by regional councils in accordance with the 2003 Freshwater Microbiological Guidelines for Marine and Freshwater Recreational Areas[2]. In contrast, we currently lack a nationally-consistent approach to managing secondary contact recreation.

78 We support the inclusion of ecosystem health as a national bottom line, recognising that this must necessarily reflect a range of states for different ecosystems. Our comments on specific national bottom lines are outlined in our submissions on the attribute tables. We are particularly concerned about the omission of pressures from introduced flora and fauna species.

79 Outcomes sought:

- Retain secondary contact recreation and ecosystem health as the national compulsory values.
- Include pressures from introduced species in the explanatory narrative for ecosystem health.

7.2 Other values

7.2.1 Fishing

80 We support the inclusion of fishing as a separate, optional value to ecosystem health. While we agree that all water bodies should support an appropriate range of species, it is important to recognise that not all water bodies should be expected to support fisheries.

81 Outcome sought:

- Retain fishing as an optional, rather than compulsory value.

[2] http://www.mfe.govt.nz/publications/water/microbiological-quality-jun03/index.html

7.2.2 *Mahi Māra*cultivation

82 We strongly support the inclusion of mahi māra as a value. Food production has been an important part of our identity throughout the history of Aotearoa/New Zealand. Not only is it central to our culture, but it now forms an integral part of our international reputation.

83 We note that the explanation defines this value in terms of food security. In our view, this narrow definition fails to encapsulate the way in which primary production supports the social fabric of rural communities and links to identity. We believe this value should be amended to recognise the importance of rural communities' connection to the land.

84 Outcome sought:

- Amend the explanation as follows.

Food ~~security~~ production – The freshwater management unit supports rural communities to grow food and fibre Food production as a value has core elements of providing essential services and wellbeing. In providing for food ~~security~~ production, rural communities would be able to access sufficient and suitable water to enable them to produce a range of foods and fibre, and to maintain or improve their connection to the land. The attributes will need to be specific to the rural needs in the catchment.

7.2.3 Contact recreation

85 We support the inclusion of swimming as an optional, rather than compulsory national value. Swimming is site-specific and time-specific (generally at low flows during warmer months). We believe it is appropriate that this value is considered and supported where it applies. However, not every water body in New Zealand is used for swimming. Accordingly, we oppose calls by some groups to have this value apply nationally, including water bodies which are not used for swimming.

86 Outcome sought:

- Retain contact recreation as an optional, rather than compulsory value.

7.2.4 *Āu Putea*economic or commercial development

87 We note that the cleaning, dilution and disposal of wastes has been deleted as a value, which was formerly included in the preamble. Water bodies have a natural cleansing capacity which has been valued and utilised for all of human history. The proposed deletion of this value is inappropriate and has not been justified.

88 Outcome sought:

- Reinstate the cleaning, dilution and disposal of wastes as a value.

8 Attribute Tables

8.1 General

89 We support immediate introduction of the National Objectives Framework and attribute tables. Regional councils are already in the process of implementing the NPSFM, setting objectives and limits. In the absence of clear national direction on scientifically robust standards, development of limits is ad-hoc, expensive and with mixed levels of rigour.

90 DairyNZ supports the development of specific, quantified, scientifically robust attributes for freshwater objectives wherever possible. This being said, we appreciate that scientifically defensible attributes and their corresponding states are not currently available for many of the values that have currently been identified. We support an iterative approach to the national objectives framework that recognises the evolving state of freshwater science.

91 Some attribute states have greater levels of underpinning evidence than others. In cases where communities are making relatively low-stakes decisions, proceeding on the best available evidence is not problematic. However, when impacts are potentially far-reaching or severe, a greater level of scientific evidence is required. Because of this, we believe that the burden of proof for proposing national bottom lines should be higher than for other attribute states.

92 Recognising the limited data currently available, we support the exclusion of temperature, suspended sediment and dissolved oxygen in the initial promulgation of the NOF. However, we support the prioritisation of research to enable these attributes to be included at a later date.

8.2 *Te hauora o te wai* – Aquatic ecosystem health

8.2.1 Macroinvertebrate Community Index (MCI)

93 The first iteration of the NOF has excluded macroinvertebrate indicators of ecosystem health. It is DairyNZ's view that this is a significant oversight. Biotic indices of ecosystem health are used throughout the world. In New Zealand the Macroinvertebrate Community Index (MCI; developed for stony streams in Taranaki in the mid-1980s) is routinely used by regional councils, consultancies and researchers for monitoring the health of hard and soft-bottomed streams[3]. In addition, nationally-accepted bands for MCI already exist and are consistent with the NOF banding approach. Attribute states are defined as A (MCI>=120), B (100>=MCI<120), C (80>=MCI<100) and D (MCI<80).

94 The recently released National River Health Indicator dataset[4] contains averaged MCI values for 1034 monitored sites from throughout NZ. Analysis of this dataset shows a strong relationship between dominant land cover upstream on the monitoring site and mean MCI

[3] A soft-bottomed variant of the MCI was developed in 2007. (Stark, J. & Maxted, J. (2007). A biotic index for New Zealand's soft-bottomed streams. NZ J. Marine & Freshwater Research. 41:43-61)
[4] http://www.mfe.govt.nz/environmental-reporting/fresh-water/river-condition-indicator/index.html

(see Figure 1 below). This indicates that MCI is a good discriminator of land use pressures on freshwater ecosystems – an important criterion for any indicator.

95 Overall, 12% of the 1034 monitored sites breached the proposed bottom line (see Table 1 below). No Natural land cover sites breached the bottom line, whereas 6, 16 and 48% of Exotic forest, Pasture and Urban sites, respectively, breached the bottom line.

Figure 1: Mean MCI Values for Dominant Land Cover Types

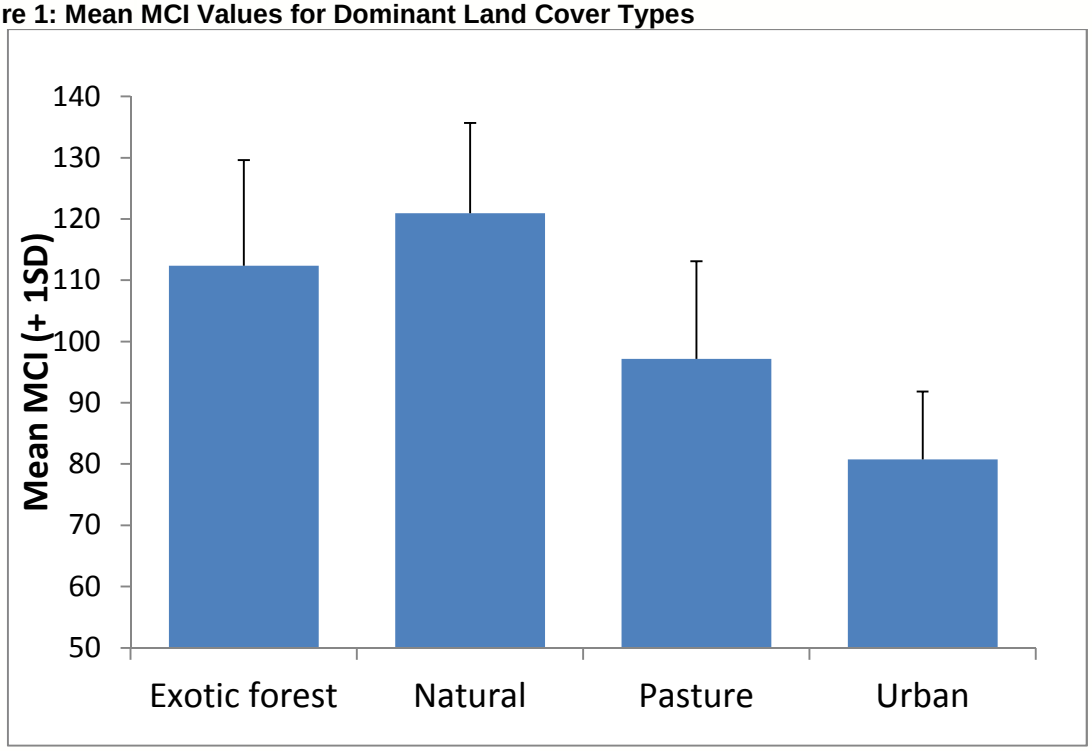


Table 1: Distribution of Sites by MCI Band and Dominant Land Cover

Dominant land cover	No. sites	% 'A' band	% 'B' band	% 'C' band	% 'D' band
Exotic Forest	47	43	36	15	6
Natural	281	55	38	7	0
Pasture	679	7	41	36	16
Urban	27	0	4	48	48
Total	**1034**	**22**	**39**	**27**	**12**

96 Outcome sought:

- Include MCI in the attribute tables for the NOF.
- Adopt the established bands i.e.

A	>120
B	100-119
C	80-99
D	<80

- It is recommended that monitoring occur annually during summer low flows and sampling methods be consistent with the accepted national protocols[5].
- If acceptable following MfE analysis of national compliance and associated economic impacts, adopt an MCI of 80 as a suitable national bottom line.

8.2.2 Periphyton

97 Periphyton plays a fundamental role in river and stream foodwebs, although at nuisance levels, periphyton can interfere with the processes and structures of these ecosystems (Hill, 1996). Periphyton has been demonstrated to observe robust relationships to indicators for resource use in New Zealand (e.g., Collier, 1995; Quinn et al., 1997; Hickey, 1998; Biggs, 2000). DairyNZ therefore supports the inclusion of a periphyton attribute for ecosystem health within the NOF.

Relationship to native biodiversity and ecosystem health

98 Many regions of New Zealand lack sufficient high quality datasets to accurately model relationships of periphyton biomass to the health of higher organisms. This is important given our support for inclusion of the MCI as an additional attribute for ecosystem health, and to ensure any guidance on the periphyton attribute is generated through its direct relationship to macroinvertebrates (and indirectly fish), rather than to aesthetic or recreational indicators.

99 Many environmental processes control macroinvertebrate abundance and richness. This limits our understanding of any direct response to periphyton (Hill, 1996; Rutherford et al., 1997). For example, changes to flow, light availability, substrate type, predation and temperature are often key drivers of macroinvertebrate diversity (Hill, 1996; Quinn et al., 1997). Variation in these variables can confound identification of a direct relationship between higher organisms like macroinvertebrates and periphyton abundance. Matheson et al (2012) acknowledged this in their recent attempt to model the direct relationship between periphyton biomass and MCI.

[5] Stark, J.; Boothroyd, I.; Harding, J.; Maxted, J.; Scarsbrook, M. 2001. Protocols for sampling macroinvertebrates in wadeable streams. Ministry for the Environment. New Zealand Macroinvertebrate Working Group Report No. 1. p. 57

100 Consequently, we believe that the periphyton attribute should not be treated as an isolated or dominant control on ecosystem health. Any risk of inappropriate management can be managed by ensuring the inclusion of MCI as a further attribute for river or stream ecosystem health.

National Bottom Line of ≤200 mg/m^2 Chl-a

101 Limited research has been conducted into the effects of periphyton upon native biodiversity in New Zealand, beyond defining a pristine or "clean-water" threshold at maximum (95th%) ≤50 mg/m^2 Chl-a (NZPG, 2000). While we support the grading of "excellent" (A) ecosystem health status for periphyton at a maximum of ≤50 mg/m^2 Chl-a, it should be noted the proposed NOF periphyton bottom-line of ≤200 mg/m^2 max Chl-a is equivalent to that recommended in the New Zealand Periphyton Guide (NZPG, 2000:102) from research into protection of trout, rather than for protection of indigenous fish.

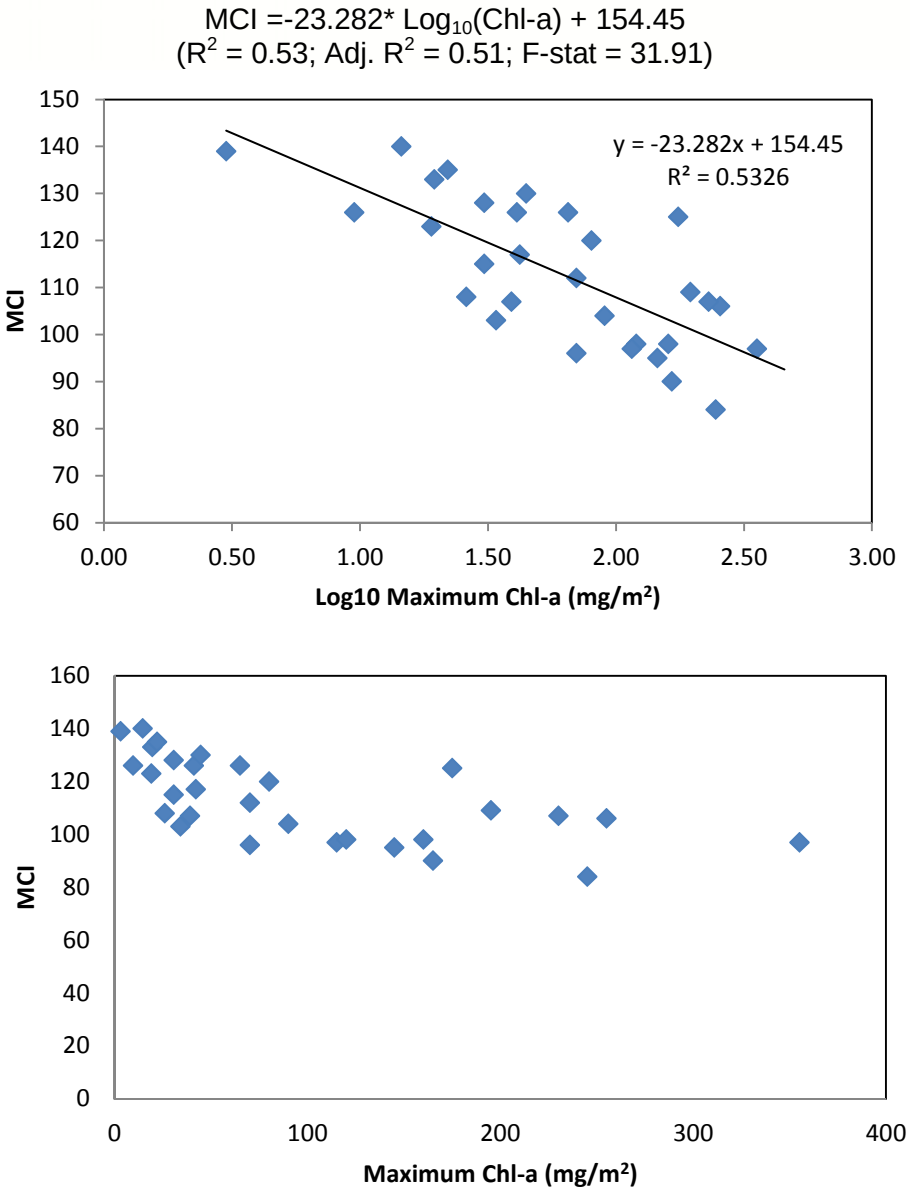
102 The introduction of trout is a disturbance and departure from "pristine" status in New Zealand's waterways through the subsequent predation and displacement of native fish, especially of endemic galaxiids (e.g., Allibone and McIntosh, 1999; McDowall, 2003). Trout have also been demonstrated to consume virtually the entire invertebrate production of many streams, thereby feeding back into a consequential proliferation of periphyton (Flecker and Townsend and 1994 Biggs et al., 2000 in McDowall et al., 2003). Research into the effects of periphyton upon trout habitat can inform guidelines for "good" (B) and "fair" (C) ecosystem health in the NOF, but it should be stressed that setting periphyton limits from observations of MCI and periphyton Chl-a in trout-dominated systems can be overly conservative for waterways without trout. This is due to the fact that native galaxiids typically consume a small fraction of macroinvertebrate production in New Zealand (e.g., Huryn, 1996, 1998; Biggs et al., 2000).

103 Matheson et al (2012) and the supplementary NOF periphyton report of Snelder et al (2013) suggest a national bottom-line of ≤200 mg/m^2 Chl-a, is associated with macroinvertebrate communities of "good" to "fair" status (MCI scores of 110-90). Snelder failed to standardise for the effects of changes to other environmental controls upon MCI, before modelling the direct relationship to only Chl-a. For example, in addition to the indirect feedback trout exert on periphyton, higher instream temperatures directly stress macroinvertebrates and favour greater periphyton biomass (Quinn et al., 1994; Cox and Rutherford, 2000). In this instance, reduced MCI would be more appropriately linked to changes in temperature than heightened periphyton abundance.

104 That data included in Matheson et al (2012) was not filtered to isolate solely those effects on MCI of Chl-a alone is most evident at Southland sites with MCI scores <90 (Figure 4-1 in Matheson et al., 2012). For these sites, the direction of the relationship between Chl-a and MCI reverses (i.e., at MCI<90 reductions in Chl-a result in further reductions in macroinvertebrate community health). Clearly at these sites, limited periphyton biomass occurs but the direct cause of reduced macroinvertebrate health might rest more appropriately with thermal, hydrological, predatory or riparian habitat pressures (i.e., both reduced MCI and Chl-a arise from some other limiting factor at Southland sites with MCI<90).

Consequently, the review by Matheson et al (2012) which formed the basis for the recommendations of the NOF periphyton review panel cannot reliably determine the maximum periphyton Chl-a directly associated with a macroinvertebrate community of "fair" status (MCI ≥ 80).

105 DairyNZ conducted an indicative analysis of data on 30 sites in the Manawatu-Whanganui region (data available in the Evidence in Chief of Dr. Mike Scarsbrook to the Proposed One Plan Hearings, paragraph 58). The relationship of MCI and normalised maximum Chl-a is highly linear, permitting a classical regression approach rather than the quantile approach adopted in Matheson et al (2012). Assuming all variance in MCI is directly attributable solely to variance in Chl-a (as in Matheson et al), changes in maximum periphyton can explain 53% of changes to MCI in a highly statistically significant relationship (p<0.001):



Figures 2 and 3: Paired periphyton Chlorophyll-a values versus macroinvertebrate community index scores for 30 sites in the Manawatu-Whanganui region.

106 From the periphyton-MCI relationship above, a "clean water" MCI score of 120 would be associated with a maximum periphyton biomass of <30 mg/m^2 Chl-a. Likewise, an MCI score of >100 would be associated with the proposed national periphyton maximum bottom-line of 200 mg/m^2 Chl-a (equivalent to 2.3 when read as Log_{10}Chl-a). From this dataset, a bottom-line of 200 mg/m^2 appears to be associated with at least "good" macroinvertebrate health. A periphyton bottom-line of 200 mg/m^2 would therefore be highly-conservative for protecting macroinvertebrates from the deleterious effects of periphyton at "fair" MCI status.

Use of Chlorophyll-a

107 We support the use of Chl-a to report on periphyton biomass. Chl-a has a greater association to biologic and geochemical indicators for water quality and resource use than other biomass indicators (per cent coverage, AFDM or pheophytin concentration), and a more robust protocol for in-field and laboratory analysis. In standardising methods for environmental monitoring and reporting (as requested in paragraph 69), the national protocol in Biggs and Kilroy (2000) should be utilised for reporting on periphyton.

108 While we maintain that analysis of Chl-a offers the most robust approach to linking the effects of land use to ecosystem health through periphyton biomass, DairyNZ appreciate that per cent cover is a lower-cost method for many regional councils. In the interest of pragmatism, DairyNZ support the use of per cent cover to report on Chl-a for the NOF, but only where a statistically significant (p<0.05) relationship has been developed between the two periphyton indicators that has been tested throughout a region's waterways to ensure broader applicability (i.e., as per Kilroy et al [2013] and the recommendations of Snelder et al [2013]). Doing so will reduce the burden of monitoring for regional councils, without loss of the greater reliability attached to Chl-a in modelling the effects of resource use on periphyton abundance, and ultimately, ecosystem health.

109 Given the emphasis of managing ecosystem health and that long-term resilience is key to the latter, permitting exceedances of maximum Chl-a is a pragmatic solution to the fact that any single sample might not be representative of periphyton biomass during the time-period between samples, nor the true risk posed to higher organisms if short-lived (Biggs and Kilroy, 2000). To accommodate this and avoid skewing reporting on periphyton, the NZPG (2000) recommend that the maximum Chl-a reported against should be read as the 95th% of observations (i.e., that 5% of observations might exceed the maximum recommended Chl-a limit without necessarily resulting in degradation of ecosystem health). Likewise, the national protocol for periphyton monitoring (Biggs and Kilroy, 2000) acknowledges that exceedances of 200 mg/m^2 Chl-a might also be of limited concern at lower temperature and/or higher flow, because the greatest concern around periphyton effects on native fish is the diurnal fluctuations this mediates in dissolved oxygen availability and pH. At conditions of low temperature, periphyton respiration rates are markedly lower and at higher flows, the greater discharge of water can mitigate the increased demand for oxygen by periphyton in excess of 50, 120 or 200 mg/m^2 Chl-a (Biggs and Kilroy, 2000).

110 DairyNZ recognises that a “productive” class is a sensible means of accounting for those limited catchments whose underlying geology and/or hydrology are naturally conducive to breaches in a periphyton Chl-a band (i.e., where conditions of low-flow, lack of scour and/or high background nutrient levels favour greater periphyton biomass [e.g., Biggs, 2000]).

111 There is a lack of information contained in the discussion document (MfE, 2013) about the total period over which Chl-a should be reported. Given the importance of flow in regulating periphyton Chl-a (Biggs, 2000) and the wide inter-annual variation in FRE3 (scouring events) in New Zealand streams (Snelder and Booker, 2012), a long-term integrated average might be better than a single year average. Scarsbrook (2006) has demonstrated that to elicit a statistically significant trend from monthly observations, a minimum of 5 years is required of water quality attributes. DairyNZ therefore recommends that reporting on NOF periphyton Chl-a be linked to a rolling 5-year average of monthly observations (i.e., n = 60).

112 Finally, we note that in the NOF Periphyton Supplementary Report, Snelder et al (2013) only compare proposed limits to modelled maximum periphyton Chl-a distributions, rather than to observed maximum periphyton Chl-a distributions (in each of the four regions chosen for analysis). To better understand compliance with proposed limits, the NOF would benefit from a real-world analysis in conjunction with the modelled REC approach included in the supplementary report.

113 Outcomes sought:

- In standardising methods for environmental monitoring and reporting (as requested in paragraph 69), use the national protocol in Biggs and Kilroy (2000) for reporting on periphyton.
- Permit the use of per cent cover as a proxy for Chl-a only where a statistically significant (p<0.05) relationship has been developed and tested on a region’s waterways, as per Kilroy et al (2013) and recommended in Snelder et al (2013).
- Prioritise research into the effects of periphyton biomass on indigenous fauna rather than introduced salmonids, in modified systems of periphyton Chl-a >50 mg/m2 (Band A for the NOF periphyton attribute).
- Provide specific evidence identifying the ecological effects of the proposed periphyton bottom line. If this cannot be provided, consider an alternative, less conservative bottom-line.
- Retain the 92nd percentile (1 exceedance in 12) approach to reporting on periphyton biomass, to prevent biasing statistics to short-lived exceedances with limited impact on ecosystem resilience.
- Clarify which exceedance approach to adopt and if that of the NOF (MfE, 2013), over what period an exceedance of two non-contiguous monthly observations can occur within any band.
- Undertake real-world analysis in conjunction with the modelled REC approach to compare NOF periphyton band limits to observed maximum Chl-a distributions.

8.2.3 Nitrate toxicity

114 DairyNZ supports the use of the proposed N toxicity thresholds to avoid adverse effects on New Zealand's surface water ecosystems. We support these thresholds as they have been derived from a range of international (and recently, national) ecotoxicological experiments, many of which have been published in international journals.

115 DairyNZ is concerned that regional councils may use the proposed nitrate toxicity thresholds for the protection of groundwater zones which contribute to spring flow, or to significant surface water baseflows. This is an inappropriate use of surface water toxicity standards as applying this surface water threshold does not take into account denitrification or any other attenuation processes. Therefore, it should be explicitly stated that these guidelines are not to be used for groundwater quality.

116 Outcome sought:

- Add an advice note explicitly stating that the surface water standards should not be used for groundwater.

8.2.4 Lakes Chl-a, TN & TP

117 We support the inclusion of Chlorophyll-a (Chl-a), total nitrogen (TN) and total phosphorus (TP) as attributes for evaluating lake ecosystem health. While these parameters do not provide a full assessment of ecosystem health, they do represent direct indicators of trophic state. Eutrophication is the primary threat to New Zealand's freshwater ecosystems. Increases in trophic state lead to significant changes in water quality and ecosystem functioning beyond baseline conditions under minimal anthropogenic influences. The inclusion of more direct attributes of ecological condition, for example indices of phytoplankton, zooplankton, macrophyte, phyto-benthos and fish, is complex and can only be supported by comprehensive ecological monitoring programs. Such monitoring programs are currently absent for many New Zealand lakes.

Trophic state

118 Primary production in New Zealand lakes may be limited either by phosphorous or nitrogen. For this reason we support the inclusion of both nutrient attributes in the assessment framework, as opposed to a phosphorous-only approach. There is also increasing evidence internationally that elevated nitrogen concentrations directly influence the distribution and structure of macrophyte communities in shallow lake systems.

119 Eutrophication in lakes generally leads to a regime shift from a low-nutrient, clear-water and macrophyte-dominated state to a high-nutrient, turbid and algal-dominated state. It therefore important that the attributes differentiating between good and poor ecosystem health capture the tipping point of this regime shift, to ensure that existing ecosystem values are adequately protected.

120 At the same time, it is important to recognise that many of New Zealand's lakes have already encountered a regime shift, either as a result of eutrophication processes or in combination with natural cycles and events. For example, in an assessment of lake water quality in 112 New Zealand lakes over the period 2005-2009, NIWA (2010) reported that 42% of lakes were eutrophic or worse.

121 The proposed narrative of attribute state for lakes below the National Bottom Line (Band D), which describes lake ecological communities at a high risk of a regime shift, does not reflect that many eutrophic lakes have already encountered a regime shift. Restoration of these systems back to a macrophyte-dominated state may not be achievable, or come at a cost which may not be acceptable to the community. We therefore propose that the term regime shift is removed from the narrative, to reflect all lakes in a persistent and degraded state, irrespective of whether a regime shift has or has not already occurred.

122 The proposed attribute state narratives do not make reference to the lakes Trophic Level Index (TLI), an existing assessment tool developed and now widely adapted throughout New Zealand to evaluate and report on lake water quality. The TLI relates directly to lake trophic state, with eutrophic lakes corresponding to a TLI score of 4 to 5 and super-eutrophic lakes 5 to 6.

123 Several significant lake restoration programs, for example Lake Rotorua and Lake Ellesmere, are currently working towards meeting water quality targets based on the TLI approach. A TLI target of 4.2 has been set to restore and protect the values of Lake Rotorua based on a rigorous scientific and community-accepted process. While this TLI water quality has now been met, the lake is likely to fall at or below the national bottom lines based on the proposed objectives framework (NIWA, 2012). The proposed limit setting process being applied to the Selwyn Te Waihora catchment to meet a proposed TLI score of 6.0 in Lake Ellesmere will also not result in this lake meeting the national bottom lines. While Lake Ellesmere is an ICOLL system and would therefore be excluded from the NOF, together with Lake Rotorua these lakes represent good examples that the thresholds for C and B bands are too conservative relative to the targets being set to reach the desired water quality values for these shallow eutrophic systems.

Relationship between TN, TP and Chl-a

124 Selection of the attribute values and states for the three indicators of lake ecosystem health are based on recommendations made by the NOF Lakes Science Panel as reported in NIWA (2012). The median annual values prescribed are believed to be based on expert judgement. As far as we understand, these are not underpinned by a robust analysis of existing water quality measurements across a wide spectrum of lake types to evaluate the relationships between pressures (TN and TP) and responses (chlorophyll-a and macrophyte biomass). It is therefore unclear whether the relationship between different attributes and values chosen within and between each attribute state reflect the expected concentration ranges, trophic state and TLI scores based on measured water quality.

125 While we do not have a comprehensive water quality dataset to make such an assessment, initial comparisons between the proposed attributes and similar indices applied internationally (European Union) suggests that the proposed nutrient attribute values are highly conservative relative to expected lake trophic state for the lower attribute states reflecting mesotrophic and eutrophic conditions (C and D in Table 3). This is supported by correlation relationships between chlorophyll-a concentration and total nitrogen or total phosphorus for 121 New Zealand lakes published by Able et al. (2010) (Figure 4). By applying the proposed chlorophyll-a attribute state variables to these relationships, the corresponding total nitrogen and total phosphorus concentrations expected at these levels of phytoplankton biomass can be calculated. The results of this assessment also suggest that the proposed nutrient attribute values are highly conservative for the B (nitrogen) and C -D (nitrogen and phosphorus) attribute states and national bottom lines (Table 3). This approach does not differentiate between different lake types and nutrient limitation states, which should also be addressed to give more confidence that the attribute values assigned reflect existing and expected phytoplankton-nutrient relationships.

Shallow and deep lakes

126 Different lake types respond differently to eutrophication pressures, requiring different approaches for assigning attribute states to different lake types. This approach has been widely applied to lakes in the European Union as part of the European Water Framework directive (e.g. see Table 2). For these systems lake depth is often used to differentiate between different lake types as a surrogate for mixing condition. We support that this approach is being suggested in the NOF for total nitrogen, but propose this is extended to chlorophyll-a and total phosphorus, to reflect the direct pressure and response relationship between these attributes.

127 We do not understand the rationale for differentiating only between seasonally stratified and polymictic lakes and why this approach is only proposed for total nitrogen and not for total phosphorus. Concentrations of both nutrients are generally higher in shallow, permanently mixed lakes than in deep, polymictic or permanently-stratified lakes due to a higher surface area to volume ratio and the direct and indirect impacts of wind-induced sediment re-suspension processes on water column transparency, internal nutrient cycling and phytoplankton and macrophyte community structure.

128 We propose that all lakes are separated into two lake types; shallow lakes which are permanently mixed and deep lakes which are temporarily (polymictic) or permanently stratified over summer. As the data required for determining mixing type is not likely to be available for all lakes, a mean water depth should be defined to separate the two lake types (for example 3m). The final selection of this depth value should be supported by a comprehensive analysis of existing data across a wide spectrum of lakes with different morphological characteristics.

Numeric attributes

129 We propose that the existing numerical states for each attribute are expanded to reflect the two lake types as follows (Table 3):

- The existing annual median chlorophyll-a and total phosphorus concentration proposed for all lake types and total nitrogen concentration for seasonally stratified and brackish lakes are assigned to deep lake types.
- The proposed annual median total nitrogen concentration for each attribute state for polymictic lakes are assigned to shallow lake types.
- New annual median total phosphorus concentrations are defined for shallow lakes based on twice the value assigned for deep lakes, or based on a more comprehensive assessment of the relationship between phytoplankton biomass and phosphorus concentration across a range of different lake types.
- New annual median chlorophyll-a concentrations are defined for shallow lakes based on twice the value assigned for deep lakes, or a lesser value as determined from a more comprehensive analysis of correlations between chlorophyll-a and total phosphorus or chlorophyll-a and total nitrogen using existing water quality data from a wide spectrum of deep and shallow lake types across New Zealand.

130 For the attribute chlorophyll-a, an annual maximum concentration is defined in addition to the annual median. Within each attribute state (band) this maximum is five times higher than the median. It is unclear how the maximum was prescribed, or how the median and maximum together should be applied. Scum formation by buoyant cyanobacteria may lead to significant temporary increases in surface chlorophyll-a concentration beyond 60 mg/m3 even in oligotrophic lakes with otherwise low to medium background nutrient concentrations. In addition, the proposed human health (secondary contact recreation) attribute states for planktonic cyanobacteria already protect against human health risks associated with cyanobacterial scum toxicity. We only support the annual maximum concentration for chlorophyll-a if appropriate sampling methodology using integrated depth samples is applied to account for the variability of algal cells with depth.

131 We seek clarification around the interpretation of ecosystem health in situations where one or more of the individual attributes fall into different bands. NIWA (2012) proposed that at least chlorophyll-a attribute state must be met and either TN and TP should fall in to the same band. We support the approach that annual median chlorophyll-a concentration is the primary attribute for determining ecosystem health in situations where TP and TN conflict.

132 Due to the considerable spatial, temporal and depth variability associated with water quality variables within and across lakes, we propose that national, robust and standardised monitoring protocols are established and applied specifically for the assessment of attributes for lake ecosystem health.

Table 2: Classification of chlorophyll-a, total nitrogen and total phosphorus into ecological classes as applied or proposed for shallow and deep lake types in Europe. Lakes represented include Denmark (Sondergaard et al. 2005, The Netherlands (STOWA 2004), Italy (Premazzi et al. 2003) and wider Europe (Moss et al. 2003). All values represent annual median concentrations.

Lake type	Parameter	Study	High	Good	Moderate	Poor	Bad	Comments
Deep	Chl-a	Sondergaard et al. 2005	_	6.5	12	27	>56	
		Moss et al. 2003	_	_	_	_	_	
		Premazzi et al. 2003	<3	6	10	25	>25	
		STOWA 2004	<5.2	8.3	14.5	29.1	>58.2	Represents lake type M21 (deep buffered lakes)
	TP	Sondergaard et al. 2005	<12.5	25	50	100	>100	
		Moss et al. 2003	_	_	_	_	_	
		Premazzi et al. 2003	<10	25	50	100	>100	
	TN	Sondergaard et al. 2005	_	1000	1000	1400	>2200	
		Moss et al. 2003	_	_	_	_	_	
		Premazzi et al. 2003	_	_	_	_	_	
Shallow	Chl-a	Sondergaard et al. 2005	<6	12	22	57	>82	
		Moss et al. 2003	<10	20	30	50	>50	As reported in Sondergaard et al. 2005
		Premazzi et al. 2003	_	_	_	_	_	
		STOWA 2004	<9.4	16.3	30	60	>120	Represents lake type M14 (shallow buffered lakes)
	TP	Sondergaard et al. 2005	<25	50	100	200	>200	
		Moss et al. 2003	<15	30	50	75	>75	As reported in Sondergaard et al. 2005
		Premazzi et al. 2003	_	_	_	_	_	
	TN	Sondergaard et al. 2005	<1000	1000	1400	2000	>2900	
		Moss et al. 2003	_	_	_	_	_	
		Premazzi et al. 2003	_	_	_	_	_	

Table 3: Comparison of total phosphorus (TP) and total nitrogen (TN) as proposed by the NOF and as calculated from proposed chlorophyll-a concentration and the relationship between chlorophyll-a and TN or TP, as described by Able et al. 2010 (Figure 4). All units are in µg L^{-1}.

Variable	Attribute state			
	A	B	C	D
Chl-a proposed	<2	2-5	5-12	>12
Calculated TP all lakes (from Chl-a)	<9	9-28	28-80	>80
Proposed TP all lakes	<10	10-20	20-50	>50
Calculated TN stratified lakes (from Chl-a)	<193	193-418	418-872	>872
Proposed TN stratified lakes	<160	160-350	350-750	>750
Calculated TN polymictic lakes (from Chl-a)	<193	193-418	418-872	>872
Proposed TN polymictic lakes	<300	300-500	500-800	>800

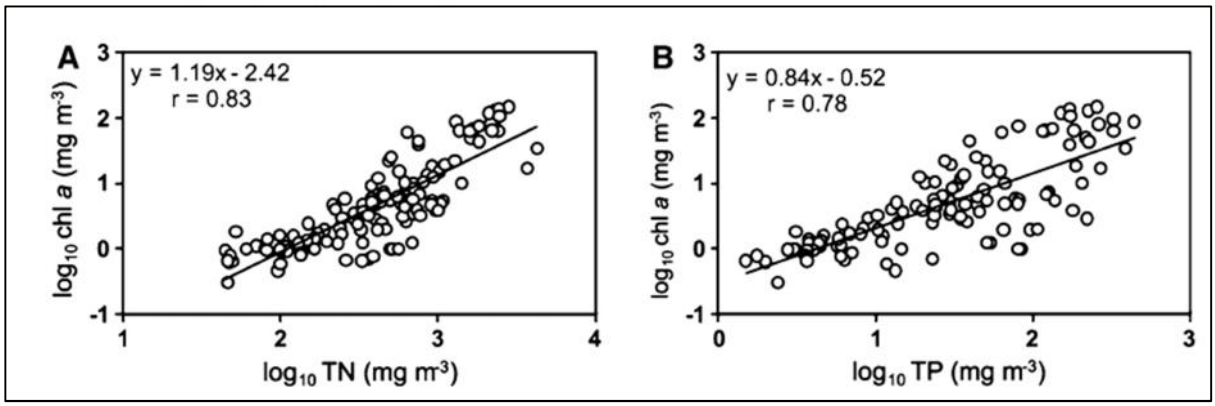


Figure 4: Regression of chlorophyll-a against total nitrogen (TN) and total phosphorus (TP) for 121 lake types from Able et al. (2010).

133 Outcomes sought:

- Retain the use of TN and TP as well as Chl-a as attributes.
- Remove the term "regime shift" to reflect lakes in a persistent and degraded state.
- Separate attributes according to shallow and deep lakes, in alignment with international practice, for TN, TP and Chl-a.
- Use existing values for deep lakes and suggested new values for shallow lakes.
- Delete reference to maximum Chl-a or formulate the maximum on a depth-integrated value.
- Provide clarity around how median Chl-a and maximum Chl-a state should be interpreted when in conflict.
- Where TN or TP are in conflict, use Chl-a as the primary attribute for determining lake ecosystem health.
- Require a robust and standardised sampling methodology.

8.3 *Te hauora o te tangata* – human health

8.3.1 Secondary contact recreation

134 We support the addition of human health (secondary contact recreations) as a national, compulsory value that applies to all water bodies throughout New Zealand. It is reasonable to assume that any waterway in the country could be used for wading or boating over much of the year and entirely appropriate that direction be given to regional councils on managing human health risks during those activities. There may be a limited number of situations where this value is not appropriate (e.g. downstream of riverbed-nesting bird populations), and these should be dealt with through a very tightly constrained exceptions schedule.

135 We support the use of E. coli as an attribute against which to measure the achievement of objectives relating to secondary contact recreation. We also support the approach taken by the Ministry for the Environment (MfE) in developing appropriate threshold values between different bands based on levels of E. coli (see Appendix).

136 Graham McBride (NIWA), an internationally-recognised expert in microbiological standards for water quality, provided threshold recommendations to MfE based on the same Quantitative Risk Assessment Model and national dataset used for the 2003 Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas[6]. These thresholds related to 0.1, 1 and 5% infection risks.

137 To identify the thresholds for secondary contact recreation McBride assumed a reduced infection risk compared with primary contact recreation. This was based on a review of international literature that showed reduced water ingestion (and hence reduced infection risk) during secondary contact recreation activities. For example, the proposed secondary contact recreation bottom line is set at a 5 per cent infection risk (equivalent to E. coli levels of 1000 cfu/100 ml), assuming water ingestion during secondary contact recreation is one quarter that during primary contact recreation. This assumption is somewhat conservative, as two overseas studies suggest secondary exposure ingestion rates were around one tenth of those used for primary contact recreation risk analysis.

138 Overall, we support the recommended E. coli thresholds assigned to the A-D bands for managing secondary contact recreation in NZ's rivers and lakes.

Compliance of monitored sites with NOF bottom line

139 We have significant concerns about the sample statistic proposed for measuring compliance against the National Bottom Line (i.e. Annual Median E. coli < 1000 cfu/100 ml). We assume this is based on a monthly monitoring programme (i.e. 12 samples/yr). The use of the Annual Median as the measure of compliance has potentially significant implications for public health risks associated with secondary contact recreation.

[6] "Issues in setting secondary contact recreation guidelines for New Zealand Freshwaters". Graham McBride, NIWA, Hamilton, N.Z. 9 September 2012. p.12

140 We used a national dataset compiled by MfE & NIWA (sourced from http://dc.niwa.co.nz/niwa_dc/srv/eng/metadata.show?id=285&currTab=simple) to assess the level of non-compliance of monitored sites with the proposed NOF bottom line (i.e. annual median E. coli >1000 cfu /100 ml) and a range of alternative compliance measures relating to the number of allowable exceedances per annum.

141 The dataset (1990-2012) contains more than 63,000 individual data points. To simplify the analyses we chose 2010 as a test year (this year had the greatest number of sample records). We then filtered the dataset to remove any sites that had not been sampled 11 or 12 times in that year (i.e. we wanted a monthly monitoring programme without significant gaps). We ended up with a total of nearly 4500 data points from 373 sites.

142 For each site we calculated the annual median and the number of samples exceeding 1000 cfu/100 ml.

143 Only 5 of the 373 sites (1.3%) had an annual median greater than 1000 cfu/100 ml. These sites included two Auckland city sites (Otaki @ Middlemore and Pakuranga @ Botany), Karori Stream in Wellington, Otautau Stream in Southland and Kaeo River in Northland.

144 If the Annual Maximum (i.e. annual maximum > 1000 cfu/100 ml) was taken as the 'Bottom line' 58% of sites would fail. If a site was allowed up to two exceedances per annum 21% of sites would fail. As the number of exceedances allowed increases the pass rate approaches that of the Annual Median (Figure 5).

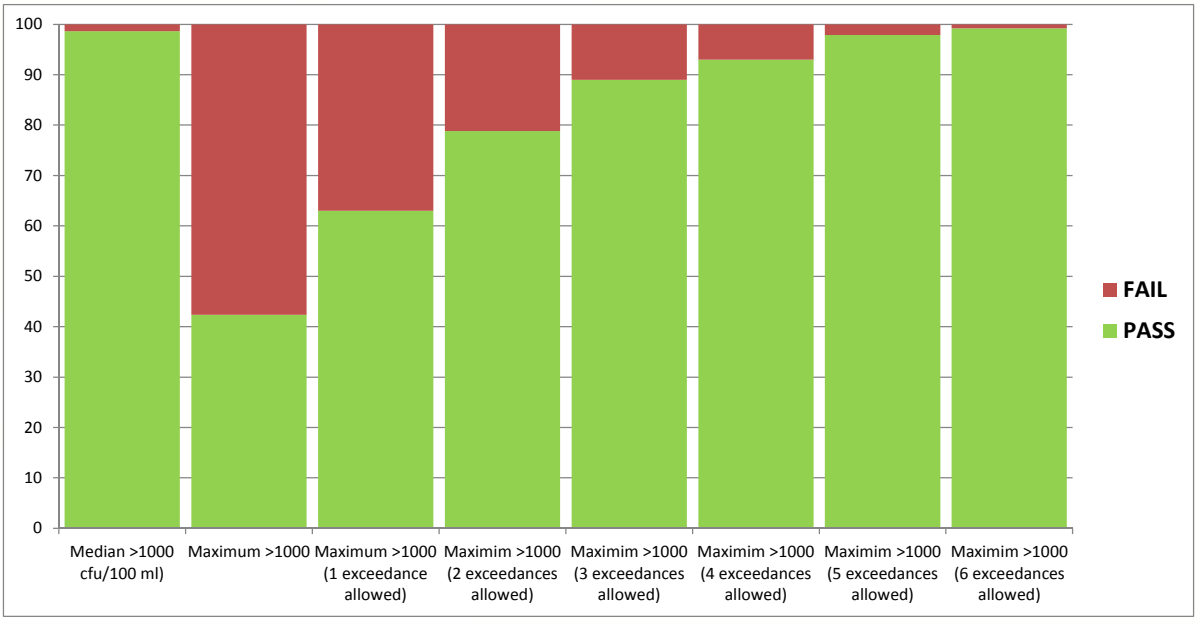


Figure 5: Percentage of sites graded as 'Pass' or 'Fail' under a range of compliance criteria. The current NOF bottom line (annual median E. coli < 1000 cfu/100 ml) is shown in the first bar.

145 In our view the use of the Annual Median to measure compliance against the E. coli attribute for secondary contact recreation provides a very low level of protection.

146 Essentially the proposed amendment is suggesting that a 5% (or greater) infection risk from secondary contact recreation is acceptable half the time. We propose a more strict compliance measure – Annual Maximum E.coli < 1000 cfu/100 ml, with no more than two exceedances allowed in any one year. This would mean sites would need to be below 1000 cfu/100 ml for more than 80% of the time. It does allow for some exceedances reflecting the likelihood of reduced recreation during some periods of the year (e.g. wet weather, cold temperatures) that are likely to coincide with elevated E. coli levels.

147 Our analysis of a 2010 dataset highlighted significant gaps in monitoring networks around the country (Figure 6). Waikato, Canterbury and Otago had relatively few sites with sufficient data to meet our criteria for this assessment (i.e. 11-12 samples per year), whereas Southland, Wellington, Horizons and Northland had more extensive datasets. This suggests that some regional councils will be required to significantly increase monitoring resources for E. coli measurement in their regions. Alternatively, compliance criteria could be developed for Councils who undertake quarterly or bimonthly sampling.

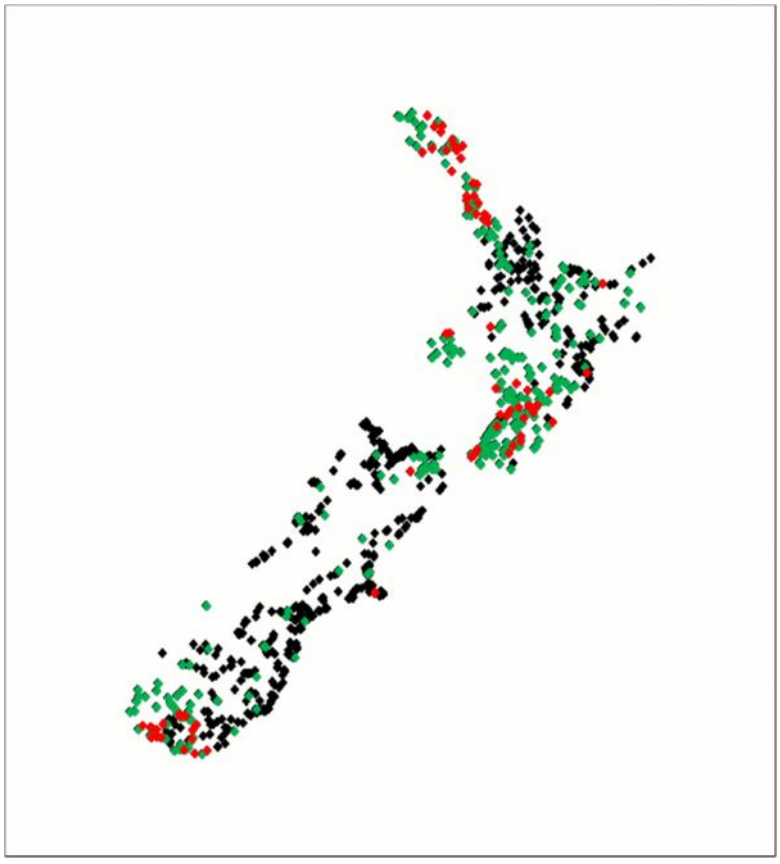


Figure 6: Map of NZ's water quality monitoring network showing sites graded as 'Pass' (green), 'Fail' (red) and 'Insufficient data' (black) in relation to a proposed secondary contact recreation bottom line of annual maximum E. coli <1000 cfu/100 ml (with no more than 2 exceedances per year). Data were from 2010. Sites needed 11 or 12 monthly samples in that year to be graded as 'Pass' or 'Fail'.

148 Outcome sought:

- Change National Bottom Line compliance measure from annual median to annual maximum (with no more than 2 exceedances allowed per year based on monthly sampling).

8.3.2 Cyanobacteria

149 A preliminary cyanobacteria banding regime for benthic and planktonic cyanobacteria was proposed by five members of the Cyanobacteria Working Group, which is a group that was established in 2008 during the development of the NZ guidelines for cyanobacteria in recreational fresh waters (MfE 2009). These preliminary recommendations were largely based on the MfE guidelines for recreational fresh waters. The applicability of the bands were tested using regional council data for selected catchments and reported in the technical review report (the report) 'Cyanobacteria band testing: examining applicability for the National (NZ) Objectives Framework' (Wood et al. 2013).

Planktonic cyanobacteria.

150 Planktonic data from Waitako and Rotorua regions were used for the analyses, comprising 17 sites (12 lakes and 1 river). The analyses examined the compliance of sites with the banding criteria that was initially proposed. This examined annual exceedences (1 or 2 exceedences per year). The analysis showed 6 of the 17 sites fell within the D band, 2 sites in the B band and 9 sites within the A band. Some sites showed considerable annual variability. The report suggested that 'the criteria for assessing a band should use a sufficiently long monitoring period and statistic that accounts for natural variability'. A smaller dataset (3 sites) was subsequently examined using an annual average of summertime data. While the three sites all fell into the D band based on annual exceedence statistics as originally calculated, one site changed to an A or B/C band when a 1 or 2 year average statistic was used. The other two sites remained within the D band based on calculation of 1 or 2 year average statistics.

151 The discussion document includes the 2-year average statistic in the Attribute State table for cyanobacteria, although that does not appear to be a direct recommendation from the report. Using a 2-year average statistic gives a lower level of protection than that provided for in the NZ cyanobacteria guidelines for recreational waters, which are based on a risk assessment for primary contact recreation. The report did not explicitly discuss the differences in risk associated with using an annual exceedence or annual average statistic nor its applicability to secondary contact recreation. However, the report did emphasise that the NZ cyanobacteria guidelines for fresh water recreation were complimentary to the NOF framework and remained important for assessing and managing seasonal risks in recreationally important fresh waters. We agree that these guidelines remain relevant.

Benthic cyanobacteria

152 In the report, analysis of benthic cyanobacteria data from was undertaken from Canterbury, Wellington and Horizons. The report recommended changes to the benthic cyanobacteria band criteria, mainly to specifically refer to Phormidium cover, as this is the only genus where there is sufficient knowledge of risks to recreational users in New Zealand rivers. Recommended changes also simplified the banding criteria, and removed references to detaching mats.

153 However, the discussion document does not include benthic cyanobacteria attributes. While there is no explanation for its exclusion based on the technical review report, we can presume that the technical experts considered that there remained considerable uncertainty in defining risks for secondary contact recreation and options for management. In general, there is good understanding of the factors that can cause planktonic cyanobacterial blooms and associated community risks. However, there is much less understanding about causative factors and options for managing benthic cyanobactiara blooms. For this reason, we support the exclusion the benthic cyanobacteria from NOF at this stage.

General comments

154 The statistic used by Woods et al. (2013) to assess the applicability of their recommended banding criteria was based on an annual exceedence value (1 or 2 exceedences of criteria per year). However, because the statistic as proposed in the NPS amendments has been changed to a two-year average based on analysis of only three sites, the discussion on page 25 of the NPS discussion document regarding the compliance of the cyanobacteria attributes does not apply to the criteria as proposed.

155 The economic impact assessment of national bottom lines refers to studies in Southland, Canterbury and Upper Waikato areas. The assessments of Canterbury were limited to the Selwyn-Wahora and Hinds zones and were based on the Landcare reports (note: the Hinds report is available on the MfE website, but not the Selwyn-Waihora economic assessment report). These assessments only focussed on the economic implications of the nitrates and phosphorus. The discussion document states ‘In the Selwyn-Waihora current plan proposals are consistent with meeting nitrate toxicity national bottom lines‘, but does not give a cost estimate of achieving the bottom line. The Selwyn-Waihora economic study did not consider the economic cost of achieving the cyanobacterial bottom line, which is likely to be considerably higher for Te Waihora/Lake Ellesmere catchment than the cost of achieving the nitrate toxicity bottom line.

156 Outcomes sought:

- Retain planktonic cyanobacteria as an attribute for secondary contact recreation.
- Undertake further analysis of achievability for a geographically broader area (preferably nationally), and further analysis of the relevance of the criteria statistic or alternatives to secondary contact recreation risks.

- Retain the exclusion of benthic cyanobacteria from NOF because of a lack of sufficient understanding of the factors causing blooms and toxin production, and therefore, limited ability to implement any strategies to control bloom development.

9 References

Able, J.M., D. Ozkundakci and D.P. Hamilton (2010). Nitrogen and phosphorus limitation of phytoplankton growth in New Zealand lakes: Implications for eutrophication control. Ecosystems 13, 966-977.

Ministry for the Environment and Ministry of Health (2009). New Zealand Guidelines for Cyanobacteria in Recreational Fresh Waters – Interim Guidelines. Prepared for the Ministry for the Environment and the Ministry of Health by SA Wood, DP Hamilton, WJ Paul, KA Safi and WM Williamson. Wellington: Ministry for the Environment.

Moss, B. and 48 co-authors (2003). The determination of ecological status in shallow lakes — a tested system (ECOFRAME) for implementation of the European Water Framework Directive. Aquatic Conservation: Marine and Freshwater Ecosystems, 13 (6), 507-549.

NIWA (2012). Classification and objective bands for monitored lakes. Prepared for the Ministry for the Environment.

NIWA (2010). Lake water quality in New Zealand 2010: Status and trends. NIWA client report HAM2010-107.

Premazzi, G., A. Dalmiglio, A. C. Cardoso, G. Chiaudani (2003). Lake management in Italy: the implications of the Water Framework Directive. Lakes and Reservoirs: research and Management, 8, 41-59.

Snelder, T., Scarsbrook, M., Larned, S. (2006). Assessment of the national pool of river water quality.

Sondergraard, M. E. Jeppesen, J.P. Jensen and S.L. Amsinck (2005). Water Framework Directive: ecological classification of Danish lakes. Journal of Applied Ecology 42, 616-629.

Stark, J.; Boothroyd, I.; Harding, J.; Maxted, J.; Scarsbrook, M. 2001. Protocols for sampling macroinvertebrates in wadeable streams. Ministry for the Environment. New Zealand Macroinvertebrate Working Group Report No. 1.

Stark, J. & Maxted, J. (2007). A biotic index for New Zealand's soft-bottomed streams. NZ J. Marine & Freshwater Research. 41, 43-61.

STOWA (2004). Referenties en concept-maatlatten voor meren voor de kaderrichtlijn water.

Wood SA, Mallet RJ, Hamilton DP, 2013. McBride CG, Hamilton DP, Cutting BT, Muraoka K and Tempero GW, 2013. Cyanobacteria band testing: Examining applicability for the National (NZ) Objectives Framework. Environmental Research Institute Report No. 12.