Established 1968

New Zealand Freshwater Sciences Society

Water Submissions

To: Ministry for the Environment

PO Box 10362

Wellington 6143

4 February 2014

Dear Minister,

FEEDBACK ON THE PROPOSED AMENDMENTS TO THE NATIONAL POLICY STATEMENT FOR FRESHWATER MANAGEMENT (2011) AND THE NATIONAL OBJECTIVES FRAMEWORK
NEW ZEALAND FRESHWATER SCIENCES SOCIETY

Introduction

1. The New Zealand Freshwater Sciences Society (NZFSS) was established in 1968 as the New Zealand Limnological Society. It is a constituent body of the Royal Society of New Zealand and has some 430 members. The Society's membership includes academics, scientists, industry and community members, students and resource managers in the field of freshwater. The NZFSS is the key professional society for practitioners in freshwater science and management in New Zealand. The Society aims to "establish effective liaison between all persons interested in any aspect of fresh or brackish water research in New Zealand, and to encourage and promote these interests".

2. The NZFSS welcomes the opportunity to comment on the discussion document entitled '*Proposed amendments to the National Policy Statement for Freshwater Management 2011*' which in addition to proposing amendments to the National Policy statement for Freshwater Management (NPS FM) includes a National Objectives Framework (NOF) that defines values for water bodies and bottom lines

for freshwater quality which will significantly change the way freshwater is managed in New Zealand.

3. The NZFSS is concerned about the widespread decline in ecological health, aquatic biodiversity and water quality in New Zealand[1]. A large proportion of the Society's membership is directly involved in resource management as experts in local government, Environment Court and central government and a number of members are accredited as independent hearings commissioners through the '*Making Good Decisions*' programme. These members have a wealth of science and resource management expertise to contribute to the freshwater reform process. Several members of the Society have been directly involved in advising on aspects of the NOF. Feedback on the NOF has provided an opportunity for the Society as a whole, to review the proposed policy and technical framework.

4. The NZFSS has provided feedback on the following matters:

    a. Amendments to the NPS FM objectives and policies and NOF values

    b. Te Mana o te Wai

    c. Tangata whenua values

    d. NOF numeric attributes

    e. National Bottom Lines

    As well as specific comments relating to:

    a. Invertebrates

    b. Fish

    c. Cyanobacteria - planktonic and benthic

    d. Estuaries

    e. Lakes

    f. Wetlands

    g. Rivers

[1] http://freshwater.science.org.nz/index.php/news/media-statement-nzfss-key-closing-messages/

h. Microbiological water quality

National Objectives Framework

5. The NZFSS **supports** the concept of a national objectives framework. The Society believes the current state and trends in water quality and aquatic biodiversity require a focussed, national approach. However, national bottom lines should not be confused with objectives. Objectives are outcome focussed whereas bottom lines are minimum thresholds/limits. The difference between these two needs to be clear in any policy or regulation. Minimum bottom lines for freshwater are not objectives to aspire to. The NOF should re-emphasise the 'maintain or enhance' approach of the NPS FM Objective A2 and the policy framework should be sufficiently robust to ensure that no water body should be allowed to degrade.

6. The NZFSS requests that the decision making around the proposed numerical attributes used in the framework. It is recommended that the report include not only the science recommendations, but also any further changes to the numeric attributes and national bottom lines beyond the science advice and recommendations (e.g., recommendations from the reference group or changes made by Ministry staff), including the reasons for any changes. This will allow scientific and other technical practitioners (e.g., policy analysts) to have transparency related to the evaluation process for each numeric attribute and how it relates to values, limits and targets at the regional level.

7. An issue raised in section 2 of the NPS FW discussion document is the lack of a clear definition for 'life supporting capacity'. The proposed national bottom lines for Ecosystem Health go only a small part of the way towards addressing this issue. We recommend that further attention is given to addressing these issues, beginning with clear narrative descriptions of the desired outcomes from which future numeric attributes for Ecosystem Health can be developed.

Amendments to the NPS FM objectives and policies

8. The NZFSS supports the government in requiring more integrated, targeted and sustainable management of New Zealand's freshwater resources as a priority. **The NZFSS strongly support the definition of compulsory values for Ecosystem Health and Human Health. It also supports and endorses the inclusion of Te Mana o te Wai as a compulsory value and an objective within the NPS FM.** We believe clear identification of these three compulsory values within the NPS FM will assist

Regional Councils and communities to better prioritise outcomes for freshwater when creating plans or setting limits. However, we note that the single stressor approach in the NOF does not address the issue of cumulative impacts from multiple stressors.

9. Ensuring that Councils and communities provide for Ecosystem Health, Human Health and Te Mana o te Wai as national objectives is central to future 'collaborative' or Schedule 1 processes to enable setting of limits consistent with the section 5 purpose of the RMA and to account at least in part for intrinsic, ecological, cultural and recreational values. The degree to which Councils and communities will manage this depends on the strength of the NPS FM policies. Ultimately, this will determine whether the compulsory values are protected for future generations or eroded over time.

10. There is some potential for conflict between Human Health and Te Mana o te Wai as national objectives. The Human Health objective is set at the level to provide for secondary contact recreation, rather than primary. One of the central issues affecting the mauri of water bodies is faecal contaminants. Setting the national Human Health objective and supporting NOF numeric attributes below that for safe swimming is unlikely to meet the expectations of iwi (or the wider community in many cases) with respect to maintaining or improving mauri or providing for Te Mana o te Wai. Resolution of this issue is imperative before any amendments to the NPS FM are made final. We recommend the government seriously consider changing the Human Health objective to provide for primary contact (and the supporting numeric attributes in the NOF) with due consideration of factors that limit achievability in rivers (e.g. high flows) built into how the objective is worded or framed.

11. The addition of the term 'significant values'[2] to Objective A2 and the proposed changes to the definition of 'outstanding freshwater bodies' to require identification in a regional policy statement or plan adds a further layer of 'burden of proof' to justify protection or recognition of values. This relies on regional councils to

[2] The term 'significant values' is not defined in the NPS FM or the RMA. Guidance on criteria to determine significance is needed to avoid the continuation of case-by-case value arguments. Methods for determining the significance of some values in rivers have been an Envirolink Tools project over recent years. These methods are documented by Hughey K, Baker M (Eds) 2010. The River Values Assessment System: Volume 1: Overview of the Method, Guidelines for Use and Application to Recreational Values. LEaP Report No.24A, Lincoln University, New Zealand.

formally recognise 'outstanding' and 'significant' water bodies, though no guidance is provided through the NPS FM.

12. The removal of the word 'quality' from Objective A2(a) and the use of the terms 'overall', 'significant values', 'outstanding waterbodies' and 'freshwater management units' do not provide protection for values at the local level. No guidance is provided on appropriate considerations for the scale of freshwater management units. This does not meet the needs of iwi and communities to provide better outcomes for their local water bodies, which may be significant to them, but struggle to meet 'significance criteria' at the regional level or be recognised by the Regional Council in a plan or policy statement. Additionally, disclosure of sites of spiritual value is not always desirable or palatable, depending on the history or relationship of Māori with the site. By their very nature, spiritual values are not always values to be shared with the wider community in planning documents.

13. To clarify Objective A2 in relation to outstanding water bodies and their values, the term 'outstanding values' in the interpretation of 'Outstanding freshwater bodies' could be changed to read 'significant values'. This would clarify the determination of significance as including values listed within the regional plan or policy statement in relation to an outstanding freshwater body. Although still problematic for the reasons outlined above, the interpretation of the policy would be clearer.

Integration with coastal waters

14. We strongly **support** the addition of references to the connections between freshwater and coastal water. Integrated management of fresh and coastal water resources and values requires consideration of connectivity between the two in plan development and decision making. In particular, the reference to the use and development of land and freshwater on coastal water in Policy C2(b) is a useful policy directive and an important planning consideration, given the context of increasing agricultural and urban intensification and the effects of this on coastal waters via rivers and groundwater.

15. Given this policy directive it is therefore critical that numeric attributes and bottom lines are set at levels which will ensure large contaminant loads are not discharged via rivers to estuaries or coastal marine waters. We wish to emphasise here that managing rivers to secondary contact standards or to nitrate or ammonia toxicity levels has the potential for large loads of faecal or nitrogenous contaminants to be

exported into the coastal environment (where nitrogen for example is often a key nutrient limiting primary production) and may mean bathing or shellfish collection standards are unable to be met in many locations, or that there is ongoing degradation of coastal water bodies.

16. If integrated management with coastal waters and the effects of discharges from freshwaters on coastal waters are not included in the NOF framework, regions will need to be clearly directed and compelled through additional policies within the NPS FM amendments to set limits and targets which account for coastal and estuarine water quality as well as Human Health, Ecosystem Health and Te Mana o te Wai values in these environments. This is likely to be a more difficult policy undertaking than to account for discharge to estuarine and coastal environments in the NOF tables.

17. Appropriate bottom lines for estuaries have not been included in the NOF framework. Estuaries are the receiving environment for discharges from our rivers and are often areas of considerable conservation, biodiversity, cultural and recreational significance. Effects on estuarine ecosystems must be accounted for in managing river water quality in particular. In the absence of limits or numeric objectives within the NZ Coastal Policy Statement (NZCPS) there is a risk that estuarine ecosystems will continue to 'fall through the cracks'. Already there is evidence of significant estuarine degradation as a result of land use and freshwater management. Examples include Tauranga Harbour, Porirua Harbour and Pauatahanui Inlet, the New River Estuary in Southland and the Firth of Thames. Many urban main centres are adjacent to estuaries and harbours, and degradation of these systems is likely to compromise recreation, cultural values and aesthetic amenity.

18. **Amendments to Policy C2 (b) provide a good platform for adding specific reference to estuaries.** An addition to Policy C2 clause (b) could be as follows (underlined text) "*land and fresh water on <u>estuaries and</u> coastal water*" or similar modification, so that consideration of estuaries is specifically required whether they are within the coastal marine area (coastal waters) or not. We understand an estuary limits group was established as part of the science background to the freshwater reforms. Technical outputs from that group will be useful to inform the limit setting process at the regional level.

Existing regional limits and economic focus

19. The NZFSS asks that the government consider the relationship of proposed national objectives and bottom lines to existing freshwater objectives and limits already in regional plans. The risk of a national objectives framework diluting or undermining robust regional objectives, limits or standards should be investigated and addressed prior to the drafting of RMA amendments or regulations. Guidance should be provided so that more stringent, locally-derived objectives and limits for freshwater are encouraged.

20. There is a risk that (i) without a strong policy framework the numeric attributes in the NOF tables will be misused to 'downgrade' or undermine more stringent limits at the regional level, (ii) the national bottom lines (lower end of the 'C band') will be misconstrued or misrepresented as best practice or all that is required for most water bodies and (iii) regions that have not yet undertaken the challenging pathway of setting limits and targets will simply adopt the national bottom lines and make no further progress towards maintaining or improving existing water quality in the context of regional/local conditions. There is those in a position to make decisions on freshwater management may not be able to differentiate between the national bottom lines and the limits and targets required at a local level to protect values.

21. The risk of a national objectives framework diluting regional objectives, limits or standards should be investigated and addressed prior to the final release of the amendments. Guidance should be provided so that appropriate, locally-derived objectives and limits for freshwater are encouraged and supported.

22. Section CA of the proposed amendments holds the bulk of policies dealing with how the NOF will be applied. Policy CA1(f) lists matters for consideration when developing objectives, identifying values and applying relevant numeric attributes. It governs the consideration of limits, the current and anticipated state based on current and past resource use, spatial scale, timeframes for achieving objectives and implications for resource users and communities "*including for actions, investments, ongoing management changes and any social and economic implications*". This clause in what is a critical policy for implementation is biased towards consideration of social and economic implications. There is no mention of ecological, recreational or cultural implications and therefore no balance to the policy.

23. It is the Society's understanding from Ministry officials that the economic implications of the numeric attributes and national bottom lines chosen for the NOF table have already been modelled and included within the decisions made on the final numeric values in the NOF attribute table. Additionally, a more economically focussed requirement has been added in the recent RMA amendments to section 32 in evaluating the cost and benefits of plans. The NZFSS made a submission opposing these changes. The section 32 lens is required for setting objectives, limits and targets in plans through the NPS FM. Further reference to the economic implications is unnecessary and may potentially replace due consideration of non-market values such as ecosystem health.

24. The purpose of the RMA is to enable social, economic and cultural well-being *WHILE* sustaining natural and physical resources to meet the needs of future generations, safeguarding the life-supporting capacity of water and avoiding, remedying, or mitigating any adverse effects (paraphrased and emphasis added). The purpose of the Act does not trade off sustaining the freshwater resource for future generations with other considerations (e.g., economics). Social and economic implications are already provided for in the purpose of the Act, which is a higher instrument than the NPS, and therefore duplication is neither appropriate nor warranted.

25. Additionally, the potential for ecological off-sets needs to be clarified in the context of overall improvement; are ecological off-sets intended or anticipated within the amended policy framework and how will they lead to improvement?

Timeframes, exceptions and freshwater management units

26. Policy CA1(f)vi allows for consideration of timeframes, including long timeframes for achieving freshwater objectives and targets. Given the allowance for unspecified and long timeframes within the policy, national bottom lines should be set conservatively as implementation costs can be offset over a longer period and innovations for improvement in land use or discharge practices are likely. **We request that the national bottom lines should be set conservatively in the numeric attribute tables to counter the potential for lag to result from long timeframes within the policies.**

27. Our additional concerns with respect to long time-frames include how the effectiveness of the NPS FM will monitored and measured over time when regions vary in their implementation timeframes.

28. Policy CA2 provides for exceptions to setting objectives at or above the national bottom lines. We believe this policy is open to interpretation. It does not ensure water quality will be maintained or improved and like all exceptions policies, it carries an inherent risk that the exceptions will become the rule[3], undermining the NOF framework.

29. There are always some legitimate exceptions, particularly when attempting to manage across a national context. However, exceptions should be explicitly listed and provisions included for the addition of new legitimate exceptions as they arise, to ensure exceptions policies are not abused. For example, Policy CA2 (a) referring to naturally occurring processes should list those processes specifically (e.g. elevated arsenic levels in freshwater from geothermal sources). Policy CA2 (b)i allows for exceptions associated with the impacts of historical activities which have caused water quality to be below the national bottom line and where reversal of impacts is not reasonably practicable physically or ecologically, even in the long term. This policy should be worded to ensure it allows only for historical activities which have ceased not those which are currently ongoing (e.g., poor land use practices that have degraded freshwater and continue to do so). Clause ii should refer to reversal that potentially causes more harm physically or ecologically than leaving the historically-degraded water body in its current, degraded state (e.g. some cases of acid mine drainage). **The term '*reasonably practicable*' should be removed from the NPS FM:** this term has no place in RMA policy as it provides no certainty. The decision of Judge Thompson on the use of 'reasonably practicable' in the Proposed One Plan supports the removal of this clause.

30. **Exceptions policies (CA2(a) and (b)) could be either deleted from the NPS FM or amended to require listing in Appendix 4 along with specific reasons for exemption.** To provide for legitimate exceptions the references to 'transitional' exemptions and timeframes could be removed from Policy CA3 and all exceptions that are not associated with significant existing infrastructure (see Appendix 3) could be listed, along with the reasons for exemption, in Appendix 4. These exceptions could be added to this list through a transparent public consultative process.

31. Policy CA2(c) and the listing of exemptions in Appendix 3 are **supported** as a specific and transparent process for exempting a water body from the national bottom lines.

[3] McArthur KJ (2012) Setting water quality limits: lessons learned from regional planning in the Manawatu-Wanganui Region. *Resource Management Theory and Practice 2012*. Journal of the Resource Management Law Association of New Zealand.

They also allow for public consultation on the exemption. It is our opinion that this is the most appropriate way to allow exceptions to the national bottom lines**. If the policy remains in the NPS FM, all exceptions under Policy CA2(a) and (b) should similarly be listed and open to scrutiny through public consultation processes.**

32. We **support** provisions requiring monitoring plans (section CB), accounting for freshwater takes and contaminant loads (section CC) and review of progressive implementation plans to align with the NPS FM amendments (section E(f))**.** Data from such accounting should be available not only for central government but to the wider science community to better enable the development of public good science around the management of freshwater resources. For example, the outputs of tools such as the CLUES[4] model of land use impacts on nutrient loads would be considerably more reliable with better availability of data relating to contaminant loads (both point source and diffuse). The uncertainties in such models could be greatly reduced, considerably enhancing their predictive powers and improving their usefulness in decision-making.

33. The requirement to account for water takes and sources of contaminants to waterbodies is sound and reasonable. However, the decision not to provide guidance on the size of the 'freshwater management unit' (FMU) undermines the value of accounting. In principle, a management unit could be so large as to obscure any differences between individual ecosystems. For example, in the Waikato catchment the FMU could be defined as being "*the whole of the Waikato River catchment from Mount Ruapehu to Port Waikato*". All of the rivers and streams in this area could thus be lumped together as a single unit ('Combined Waikato River'), and all the lakes, ponds and wetlands could also be lumped together ('Combined Waikato Lakes').

34. In this hypothetical extreme case, the differing management needs for the excellent water quality of the reach of the Waikato River immediately downstream of Taupo Gates and the degraded water quality of a number of small lowland streams would be obscured. Similarly, the differing needs for the excellent water quality of Lake Taupo and the degraded water quality of the shallow lowland lakes and ponds would be obscured. The water quality of both the 'Combined Waikato River' and the 'Combined Waikato Lakes' FMUs may be considered as good-to-excellent (state A

[4]http://www.niwa.co.nz/freshwater/our-services/clues-%E2%80%93-catchment-land-use-for-environmental-sustainability-model

for all attributes) such that the proposed national bottom lines would be irrelevant, although some water bodies may be well below them.

35. Without providing direction or guidance on the size of the proposed FMUs there is a potential to undermine the usefulness of the proposal to require accounting of takes and sources. The NZFSS asks that further work to define and provide guidance on the definition of FMUs is carried out before Councils are required to implement the proposed NOF. Tools and methods are available to assist with setting appropriately sized sub-catchments for limit setting. The Society is happy to provide advice in this area if required.

Te Mana o te Wai

36. Te Mana o te Wai is about the holistic health of a water body and linkages of people to freshwater. This paradigm seems fitting as an overarching outcome of the NPS FM. The Society supports the addition of Te Mana o te Wai as a compulsory value in the NPS and within the framework of Objective A1(c). However the proposed amendments do not adequately provide for Te Mana o te Wai. As the proposed amendments stand, communities can choose to manage for particular values and not others that contribute to Te Mana o te Wai. For example, the additional value of Natural form and character is stated in the Appendix 1 table as contributing to Te Mana o te Wai, but application of this value is not compulsory. Other additional values which are stated as contributing to Mana Tangata are also not compulsory; many of these values are considered by iwi to significantly contribute to Te Mana o te Wai. The linkages between these concepts are not well developed. In particular swimmable and fishable freshwater are key considerations with respect to Te Mana o te Wai. Further work and guidance are required by central government to ensure that Te Mana o te Wai becomes a compulsory value and to clearly direct how it is to be implemented by local authorities.

Tangata whenua values

37. The Society recognises the importance of tangata whenua values and their inclusion throughout the NPS FM. We support a strong co-governance framework for freshwater management. Cultural values need to be embedded in objective setting and monitoring of the NPS FM. Cultural monitoring is occurring across the country, yet is relatively rarely included in local authority decision-making processes. The Society considers that further work and guidance are required in the delivery of

Objective D to incorporate tangata whenua interests and values in national and regional objectives and monitoring programmes.

Natural character

38. The preservation of the natural character of rivers, lakes, and wetlands, and the protection of them from inappropriate subdivision, use and development is a matter of national importance under the RMA s6(a). Not designating the 'Natural Form and Character' as a compulsory national value is inconsistent with the degree of national importance placed on natural character within section 6 of the Act. In regards to the natural character of rivers this includes the geomorphology of the river, including pools, runs, riffles, sediment transport, active channel width and connectivity with the floodplain, wetlands and downstream systems. Natural character also incorporates the natural hydrological regime, riparian margins and water quality attributes. Natural character therefore exists even in modified systems. **We recommend the NOF should be amended to include the 'natural form and character of rivers, lakes, wetlands and estuaries' as a compulsory national value.**

NOF numeric attributes

39. The cost to Regional Councils of monitoring each of the NOF attributes requires careful consideration when deciding between particular attributes for similar purposes. For example, applying the periphyton biomass attribute for rivers rather than periphyton percentage cover incurs a significant additional cost for any Regional Council monitoring programme. This may influence the number of sites and the spatial scale of monitoring by a Council and this may in turn influence the size of Freshwater Management Units.

40. The ease with which iwi, communities and other NGO stakeholder groups can monitor their local water bodies and audit or augment Regional Council monitoring should also be taken into account when deciding between multiple attributes for similar purposes. Visual assessment monitoring (such as for periphyton as described above) is significantly less costly and yields immediate results compared with the collection of samples for laboratory analyses.

Dissolved oxygen

41. Notwithstanding its undoubted ecological significance, there are several potential difficulties associated with the proposed minimum dissolved oxygen concentration

in rivers as an attribute for ecological health below point sources. 'Below point sources' implies that the concern is dissolved oxygen depletion associated with the discharge of partially-treated organic wastewaters (e.g. sewage, dairy factory and meatworks wastewaters). Not all point sources involve such a discharge, for example (1) discharges of suspended sediment in stormwater from a quarry or (2) discharges of heavy metals from a tannery or electroplating operation. For many point source discharges around the country, the potential for adverse effects from oxygen demand has been addressed in recent decades through upgraded treatment systems. Biochemical oxygen demand (BOD) in rivers downstream of point sources has significantly reduced over time at impacted sites in the national monitoring network[5]. Dissolved oxygen reductions from point sources, while still a problem for some discharges into rivers, are largely an historic issue in freshwater management.

42. Dissolved oxygen is also highly sensitive to changes in plant biomass and can vary widely on a daily basis, particularly when elevated nutrient levels from diffuse inputs encourage excessive plant or algal growth. Adverse effects from reduced dissolved oxygen are not limited to a reduced number of point-source discharges. Any numeric attribute for dissolved oxygen needs to consider cumulative effects from diffuse inputs to be fully effective.

43. **The NZFSS recommends that the proposed numeric attribute for dissolved oxygen below point sources in rivers is removed from the NOF tables. A replacement numeric attribute for the general state of dissolved oxygen in all freshwater ecosystems needs to be included.** The potential costs and resources required to effectively monitor daily minimum dissolved oxygen (the critical statistic in relation to Ecosystem Health) should be a consideration for any additional DO numeric attribute.

Use of nitrate toxicity thresholds to provide for Ecosystem Health

44. Page 16 of the discussion document considers the effects of nitrate toxicity on the Ecosystem Health value. The attributes that currently have numeric states for ecosystem health in rivers include nitrate nitrogen and ammonia (toxicity), dissolved oxygen levels below point sources, and a measure of periphyton biomass. The attributes that currently have numeric states for ecosystem health in lakes include

[5] Scarsbrook MR (2006) State and trends in the National Water Quality Network (1989–2005). NIWA Client Report HAM2006–131 Prepared for the Ministry for the Environment, Wellington, New Zealand.

nitrate nitrogen and ammonia (toxicity), chlorophyll *a* (algal biomass), total nitrogen and total phosphorus. There is a clear disconnect between management to provide for ecosystem health in lakes and that proposed for rivers, particularly with respect to eutrophication from nutrient enrichment in rivers.

45. Nitrate toxicity bands and national bottom lines proposed in the NOF will not protect rivers against the effects of eutrophication and will only provide for Ecosystem Health values and the life-supporting capacity of water at the extreme end of the spectrum (i.e. avoiding toxic effects and mortality). To illustrate this,

46. Figure 1 shows the median total nitrogen (TN) concentrations (which include all species of nitrogen of which nitrate nitrogen and ammonia are only components) as well as the 5^{th} and 95^{th} percentiles measured in New Zealand rivers. The toxicity bottom line proposed in the NOF (6900 µg/L or 6.9 mg/L) is 5 to 6 times higher than the 95^{th} percentile of TN measured in New Zealand rivers (around 1100 µg/L or 1.1 mg/L).

47. An assessment of current median nitrate concentrations against the proposed NOF nitrate toxicity attributes shows that setting nitrogen concentrations at toxicity levels will result in significant degradation of water quality in New Zealand, and will place New Zealand (depending on the attribute band for nitrate toxicity) within the 8 worst rivers in OECD countries for water quality (based on a nitrate toxicity attribute of 3.8 mg/L which is less than the proposed national bottom line median of 6.9 mg/L). According to OECD figures, achieving the limits proposed for band B will achieve nitrate levels that would still be in excess of those measured in the Yangtze River in China or the Mississippi River in the USA (Figure 2). Currently New Zealand's low-elevation rivers (most impacted by land use intensification and urbanisation) have median nitrate concentration of 0.55 mg/L and the median derived from the National Rivers Water Quality Monitoring Network sites is 0.150 mg/L. While these concentrations fall within the concentrations often recommended to protect ecosystem health and limit periphyton growth, they are around 58% to 148% less than the toxicity-based NOF for band 'A' pristine sites for nitrate, and 170.5% to 192% less than the 'B' band.

48. Currently, even the median nitrate concentration in the Waikato and Manawatu Rivers are 0.355 mg/L (Waikato River at Huntly) and 0.559 mg/L, respectively (Manawatu River at Palmerston North). Only Canterbury spring-fed streams (1.8 mg/L) and the major inflow streams to Lake Rotorua (0.670 - 1.4 mg/L) have nitrate

concentrations close to the proposed N toxicity attributes in the NOF for bands A and B. The narrative attribute states for these bands considers them to provide for healthy to slightly impacted systems, however we know that these sites have significantly compromised ecosystem health and require rehabilitation.

49. Although we understand the eco-toxicological rationale underpinning the derivation of numeric attributes for toxicity[6] we fail to see how a nitrate toxicity attribute will safeguard ecosystem health from the more pervasive and likely effects of eutrophication from nitrogen and phosphorus in rivers.

50. Eutrophication associated with nitrogen and phosphorus pollution is undoubtedly one of the major threats to the associated values of ecosystem health and life supporting capacity in New Zealand freshwaters. In the case of nitrogen, dissolved species can cause severe eutrophication problems at concentrations that are far lower than those necessary for toxic effects. The overwhelming consensus of both international and national policy guidance and peer reviewed published literature is that both nitrogen and phosphorus pollution need to be controlled to mitigate the adverse ecological effects of eutrophication, particularly in catchments that are upstream of sensitive receiving coastal waters.

51. Relying solely on nitrate and ammonia (toxicity) as the key numeric attributes for nutrients in rivers risks adoption of local and regional policies and regulations indicating that nitrogenous contaminants are able to be increased up to toxic levels without adverse effects on Ecosystem Health either in rivers or the downstream ecosystems (i.e. lakes, estuaries and coastal waters) that are the receiving bodies for contaminants in rivers.

52. The NOF attributes for nitrogen do not reflect the fact that significant adverse effects to ecosystem health are associated with concentrations that are much lower than those at which toxic effects have been detected in the laboratory. If numeric attributes for nitrate toxicity are the only nitrogen limits considered for rivers, there is potential for New Zealand's rivers to become some of the most nitrogen-polluted amongst OECD countries whilst still remaining compliant with the NOF attributes. Protection will be afforded only through Councils and communities setting nitrogen limits for Ecosystem Health at levels less than toxicity; a task that has proven to be

[6] Hickey CW (2013) Updating nitrate toxicity effects on freshwater aquatic species. Prepared for Ministry of Building, Innovation and Employment: Funded by Envirolink. NIWA Client Report HAM2013-009.

drawn-out, costly and contentious to this point in time. Furthermore, the numeric attributes for nitrate do not recognise the potential for long lag times that are often associated with the transport of nitrate via groundwater at the landscape scale. This may result in future nitrogen pollution that is extremely difficult and costly to remedy and manage should it be decided later that lower levels are desirable in the future.

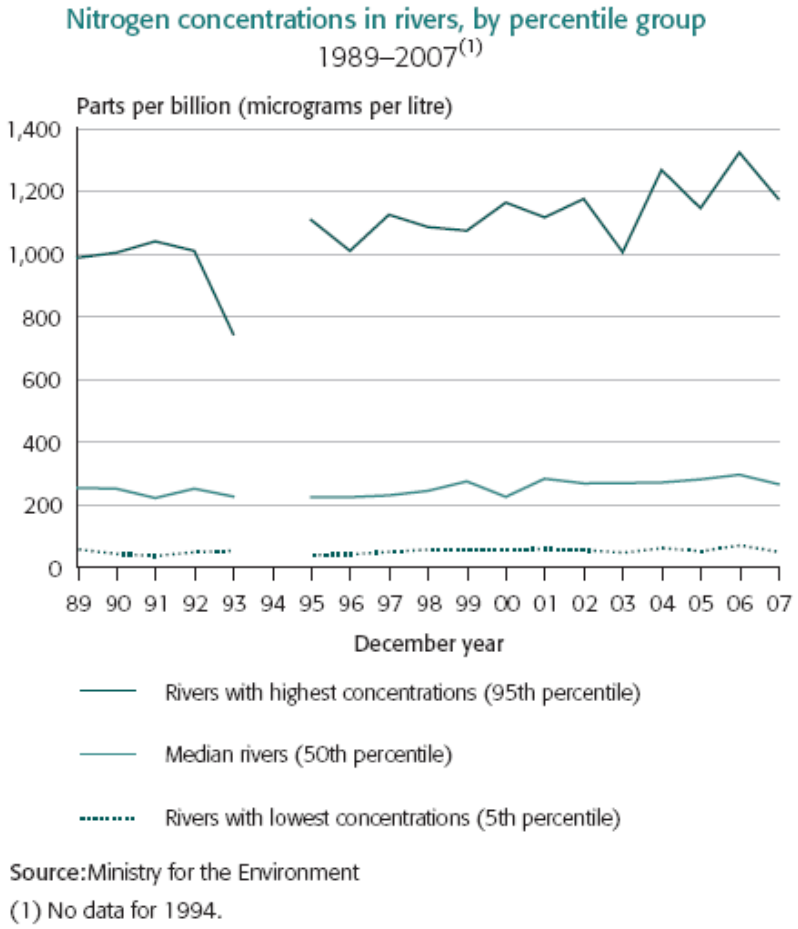

Figure 1. Total nitrogen concentrations in New Zealand rivers from 1987-2007. Source: Statistics NZ - http://www.stats.govt.nz/browse_for_stats/environment/sustainable_development/sustainable-development/water.aspx

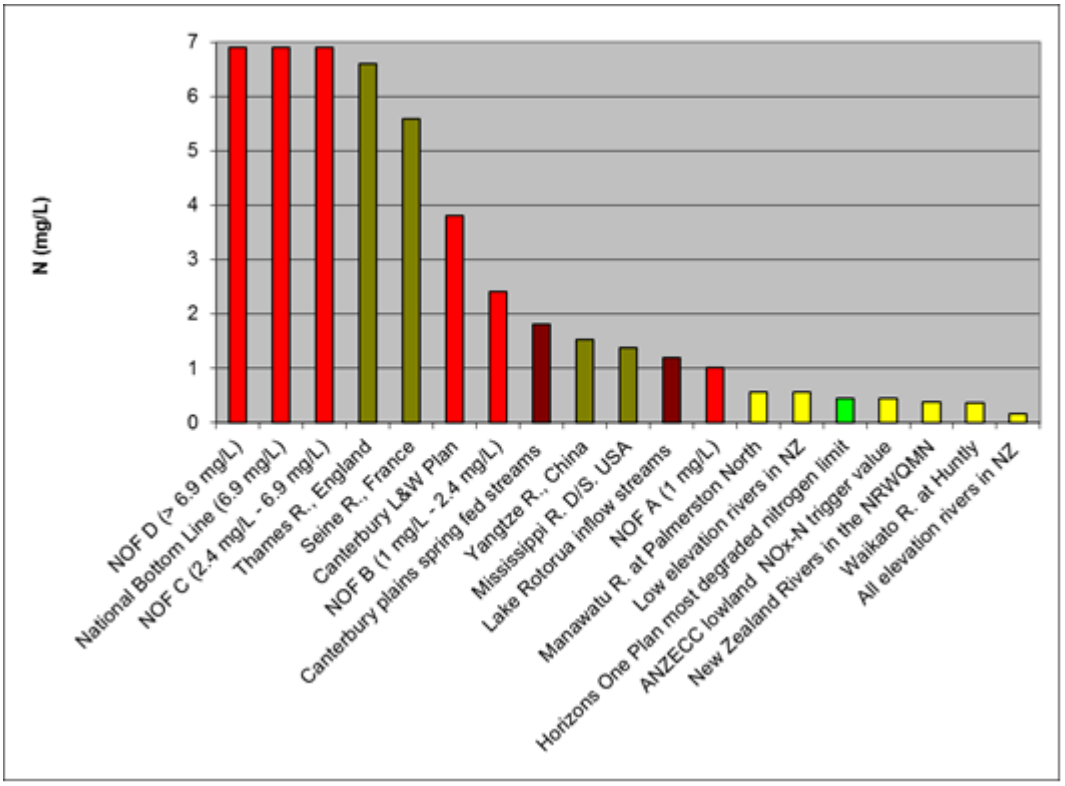

Figure 2. Nitrogen concentrations for selected rivers worldwide in reference to the NOF nitrate toxicity 'bands'.

53. Data sources for Figure 2 include average nitrate concentrations measured in major rivers in OECD countries[7]. the Thames (U.K.) which is acknowledged to have a major problem with nitrogen pollution that is proving very difficult to address despite decades of concerted effort to do so[8], numerous rivers that are renowned for experiencing major nitrogen pollution including the Mississippi River in the U.S.A.[9] in which high nitrogen loads are a major driving factor that has resulted in the formation of a 'dead zone' of low oxygen concentrations in the Gulf of Mexico[10], the River Rhône which drains a relatively highly populated and largely agricultural region of central Europe, discharging into the Mediterranean Sea where it has been identified as a major source of nitrogen that contributes to water quality decline

[7] Organisation for Economic Co–operation and Development (OECD) (2008) OECD Environmental Data Compendium 2006–2008: Inland Waters. Available online: http://www.oecd.org/env/indicators-modelling-outlooks/oecdenvironmentaldatacompendium.htm. Accessed 05/12/13.

[8] Howden N. J. K., Burt T. P., Worrall F., Whelan M. J., Bieroza M. (2010) Nitrate concentrations and fluxes in the River Thames over 140 years (1868–2008): are increases irreversible? *Hydrological Processes* 24: 2657–2662.

[9] See also concentrations reported in: Sprague L. A., Hirsch R. M., Aulenbach B. T. (2011) Nitrate in the Mississippi River and Its Tributaries, 1980 to 2008: Are We Making Progress? *Environmental Science & Technology* 45: 7209–721.

[10] Rabalais N. R., Turner R. E., Wiseman Jr. W. J. (2002) Gulf of Mexico Hypoxia, A.K.A. "The Dead Zone" *Annual Review of Ecology and Systematics* 33: 235–263.

associated with eutrophication[11], a study that measured nitrate concentrations in single samples from 21 sites in the middle and lower reaches of the Yangtze River (China) As has been widely reported, the lower reaches of the Yangtze River and the receiving coastal waters of the East China Sea regularly experience major harmful algal blooms which have been attributed to elevated concentrations of nutrients, including dissolved nitrogen[12].

Invertebrates

54. Appendix 2 attributes provide a limited selection of those needed to provide for the Ecosystem and Human Health values and do not include all attributes identified in the table on page 21 of the discussion document which includes attributes '*that may be included in future amendments once the science is agreed*'.

55. Periphyton biomass bands[13] were derived with consideration of the relationship between periphyton abundance and invertebrates represented by the Macroinvertebrate Community Index (MCI), recognising the importance and value of invertebrates as indicators of river ecological health.

56. The NZFSS considers that the Macroinvertebrate Community Index (MCI) provides a measure for the invertebrates attribute that should be included in the current version of the NOF. The MCI was developed as an index of pollution tolerance[14] and has been shown in numerous studies to respond in a predictable way to land use and nutrient enrichment. The MCI already has narrative bands that have been used by Ministry for the Environment and Regional Councils to report on the ecological health of rivers for more than 20 years. It is well understood by scientists and river managers alike.

57. The NZFSS recognises that MCI may vary in relation to natural factors, is generally only applicable in hard bottomed, wadeable rivers (unless the soft-bottomed MCI

[11] Ludwig W., Bouwman A. F., Dumont E., Lespinas F. (2010) Water and nutrient fluxes from major Mediterranean and Black Sea rivers: Past and future trends and their implications for the basin-scale budgets Global Biogeochemical Cycles 24: 1944-9224.
[12] Li M. T., Xu K. Q., Watanabe M., Chen Z. Y. (2007) Long-term variations in dissolved silicate, nitrogen, and phosphorus flux from the Yangtze River into the East China Sea and impacts on estuarine ecosystem *Estuarine Coastal and Shelf Science* 71: 3–12.
[13] Snelder T, Biggs B, Kilroy C. Booker D (2013) National Objective Framework for Periphyton. Prepared for the Ministry for the Environment by the National Institute of Water and Atmospheric Research (NIWA). 39 pages.
[14] Stark JD (1985) A macroinvertebrate community index of water quality for stony streams. Water and soil miscellaneous publication 87. National Water and Soil Conservation Authority, Wellington.

variant[15] is applied), and does not respond to all stressors. Consideration of reference condition can be added to bands by comparison to a relevant measured or predicted reference MCI value. Models with strong predictive capacity (better than that observed for periphyton) exist and can be used to inform reference state for currently unmonitored rivers[16] where comparable reference sites do not exist

58. The deviation from reference MCI value and the statistic used (e.g., summer value, monthly mean, 3-year rolling mean) will need to be determined. NZFSS considers MCI a primary attribute and recommends that any science required for it to meet the requirements of a NOF attribute be a priority so that MCI in the NOF can be reviewed and updated in a timely manner. **In the interim we strongly recommend incorporating the current MCI into the final NOF Appendix 2 table to apply to wadeable rivers nationally.**

[15] Stark JD, Maxted JR (2007) A user guide for the Macroinvertebrate Community Index. Prepared for the Ministry for the Environment. Cawthron Report No.1166. 58 p

[16] Clapcott J, Goodwin E, Snelder T (2013) Predictive models of benthic macroinvertebrate metrics. Prepared for Ministry for the Environment. Cawthron Report No. 2301. 32 p.

59. **The Society recommends adopting the MCI into the NOF attribute table as follows:**

Value	Ecosystem Health	
Freshwater Body Type	Rivers	
Attribute	Macroinvertebrate Community Index (MCI)	
Attribute Unit	MCI score	
Attribute State	**Numeric Attribute State**	**Narrative Attribute State**
A	> 120	Clean water River ecological communities are healthy and resilient, similar to natural reference conditions
B	100-120	River ecological communities are likely to be subject to doubtful water quality or mild pollution
C	80-100	River ecological communities are probably subject to moderate pollution
National Bottom Line	**80**	
D	< 80	River ecological communities are probably subject to severe pollution

Sediment

60. We recognise that increased levels of suspended and deposited sediment can have significant effects on stream ecosystems. Increased sediment loads can:

- smother natural stream beds;
- reduce water clarity and increase turbidity;
- decrease primary production through reduced light levels;
- decrease dissolved oxygen;
- cause changes to benthic fauna (fish and invertebrates);
- kill fish and invertebrates;
- reduce resistance to disease;
- reduce visual feeding ability of fish

- reduce growth rates; and
- impair spawning, and successful egg and alevins (emerged trout) development.

61. **We support the inclusion of sediment as an Ecosystem Health attribute and recommend that the science required to include a suspended sediment numeric be addressed as a priority**.

62. **The Society considers that the science to support a numeric attribute for deposited sediment in rivers is sufficiently advanced to support its inclusion in the interim.**

63. Excessive deposition of sediment can have impacts on a number of Ecosystem Health and recreational values for freshwater. Excess sediment directly affects the health of a waterbody, decreasing its life supporting capacity or mauri. Deposited sediment can clog interstices of streambed substrates (spaced between rocks and gravel) leading to a reduction in water exchange between the substrate and surface waters and causing the interstitial layer of the bed to become oxygen depleted. This can have significant impacts on fish spawning and native fish habitats and refugia during droughts and floods. Silt accumulation can bring about a change in invertebrate communities, with a loss of stonefly and mayfly species and an increase in densities of animals such as chironomids (midges) and oligochaetes (worms)[17] which adversely impact on fish feeding and hence the health and sustainability of fisheries.

64. High deposited sediment levels also adversely impact on trout and native fish spawning success by smothering gravels or interstitial spaces and reducing the flow of water and consequently dissolved oxygen and the removal of metabolic wastes for eggs or alevins.

65. Scientifically robust protocols and limits for deposited sediment have been defined[18]. These include <25% cover to provide for amenity values and <20% cover to provide for stream biodiversity and fish habitat. However, Clapcott and colleagues also state "*We recommend that these numerical guidelines provide upper*

[17] Suren AM (2005) Effects of deposited sediment on patch selection by two grazing stream invertebrates. *Hydrobiologia 549*: 205-218; Burdon FJ, McIntosh AR, Harding JS (2013) Habitat loss drives threshold response of benthic invertebrate communities to deposited sediment in agricultural streams. *Ecological Applications 23*:1036–1047.

[18] Clapcott J, Young R, Harding J, Matthaei C, Quinn J, Death R 2011. Sediment Assessment Methods – Protocols and guidelines for assessing the effects of deposited fine sediment on in stream values. Cawthron Institute, Nelson, New Zealand.

limits on the amount of fine sediment that will affect in-stream values, i.e. any amount of sediment greater than 20% cover will detrimentally affect biodiversity and fish habitat. Note that there are likely to be lower limits at which in-stream value levels will be negatively affected by sediment". In recognition of the impacts of deposited sediment on biodiversity and fish habitat and in particular salmonid spawning, it is recommended that a deposited sediment limit of <10% or <10% change from reference condition, is set for pristine sites. As stated by Clapcott and colleagues "*10 – 20% sediment provides adequate to poor spawning habitat (embryo survival will be affected), less than 10% is good and no sediment is optimal*".

66. The deviation from reference and reference sediment values need further work to determine appropriate numeric attributes for both gravel and non-gravel dominated rivers. We consider deposited sediment a primary attribute and recommend that any science required for it to meet the requirements of a NOF attribute be a priority so that deposited sediment inclusion in the NOF can be reviewed and updated in a timely manner. In light of these facts and concerns, **we recommend a deposited sediment limit for gravel wadeable rivers as follows**:

Value	Ecosystem Health	
Freshwater Body Type	Rivers	
Attribute	Deposited sediment	
Attribute Unit	Fine sediment (<2mm diameter)	
Attribute State	**Numeric Attribute State**	**Narrative Attribute State**
	Max percentage visual cover	
A	10 or within 10 of reference	Clean water. River ecological communities are healthy and resilient, similar to natural reference conditions.
B	10 – 20	Stream biodiversity and fish habitat is provided for. Fish spawning may be impacted.
C	20 - 30	Biodiversity and fish habitats are detrimentally impacted. River ecological communities are impacted. At >25% cover amenity values are compromised.
National Bottom Line	**30**	
D	< 30	River ecological communities are subject to severe impacts.

Periphyton

67. In Appendix 2 the periphyton numeric attribute for rivers suggests that the annual maximum should be exceeded on no more than two occasions. The relevant science report proposes an exceedence frequency of once in the average year, based on monthly measurements of periphyton biomass (chlorophyll *a*). **The Society recommends that the footnote to the periphyton numeric attribute for rivers is changed to exceed the annual maximum on no more than one occasion**, reflecting the technical recommendation of the science report.
68. Consideration of the costs and resources required to monitor chlorophyll *a* in favour of periphyton percentage cover by visual assessment should also be considered as noted above.

Fish

69. Fish are an extremely important ecological component of freshwaters in New Zealand and they have immense recreational, commercial, customary, and conservation relevance. The viability of nationally popular activities such as trout-fishing, whitebaiting and eeling and the preservation of endemic nationally critical fish, are reliant on maintaining healthy functioning aquatic ecosystems with intact connectivity. As such, the inclusion of ecological indicators for species with long lifespans is essential for effectively evaluating the 'health' of the nation's waterbodies and managing their functional components in the long-term.

70. With respect to fish, NZFSS members accept that the development or refinement of ecological indicators for use at a national scale is required. However, centrally led co-ordination of their collection must occur now if they are to be included in any future national objective or regional limit setting assessments. Initiatives such as NeMAR must be seen through and integrated into regional monitoring frameworks to enable this to happen in a timely manner.

71. Fish communities provide excellent measures of overall ecosystem health and state because the species comprising the fish community are sensitive to changes in water quality, river flows and habitat. They are relatively long-lived and so integrate changes over many years. They also integrate changes occurring at lower trophic levels (i.e. periphyton and invertebrates) and at smaller spatial scales. The status of fish communities in rivers is also of great interest to the public and especially to iwi. As such, fish and mahinga kai values are an integral aspect of Te Mana o te Wai as well as the Ecosystem Health value.

72. Fish population dynamics vary greatly from year to year depending on recruitment and mortality patterns, hence comparisons between fish communities for gauging ecosystem health need to be conducted over appropriate time scales. Changes due to natural variation can be expected within annual time scales; therefore trends over longer time scales (i.e. 5 years or more) are required to identify changes in the state of fish communities.

73. Fish are highly mobile and species distributions vary within and between rivers and lakes such that meaningful measures of their status as indicators of ecosystem health will be required over large spatial scales. For most freshwater fish species in

New Zealand river catchments (headwaters to the sea) are islands within a terrestrial landscape and are therefore the appropriate ecosystem scale within which differences in fish community state (as measures of ecosystem health) can be sensibly compared. Migratory fish are an important ecological attribute to assess catchment connectivity. **We recommend the development of a fish indicator to be included in any future review of the NOF.** However, such development is a two-step process with adequate fish community data collection to be a national monitoring priority to facilitate such index development. Funding for consistent monitoring is also an issue.

Cyanobacteria - planktonic

74. The current planktonic cyanobacteria NOF bands use threshold values slightly modified from those in the 'New Zealand Guidelines for Managing Cyanobacteria in Recreational Fresh Water'[19]. These threshold values were designed to trigger a series of management actions when there is a *single exceedance* of the guideline. In the NOF, these same values are applied as two-year averages which are inappropriate to provide for Human Health values. The current interpretation of these values within the NOF allows "banding" which may fail to protect human health during recreational activities. Testing by Wood and colleagues[20] showed that when using a two-year average, sites that pose a significant health risk for extended periods of time were commonly categorised in a higher (i.e., better) band than appropriate simply due to the statistic used. We recommend that further analysis of long-term data sets is undertaken to develop an appropriate 'banding statistic'.

Cyanobacteria - benthic

75. During the past seven years there has been an apparent increase in blooms of the benthic cyanobacterium *Phormidium* in New Zealand rivers. *Phormidium* produces powerful neuromuscular-blocking toxins, which pose a threat to humans and animals. There is strong community interest in *Phormidium* due to frequent dog deaths. At the same time health warnings erected along rivers are creating significant public animosity towards councils. An appropriate balance between risk

[19] Ministry for the Environment and Ministry of Health. 2009. New Zealand Guidelines for Managing Cyanobacteria in Recreational Fresh Waters – Interim guidelines. Prepared for the Ministry for the Environment and the Ministry of Health by S.A. Wood, D.P. Hamilton, W.J. Paul, K.A. Safi, W.M. Williamson. Wellington: Ministry for the Environment. 89 p.

[20] Wood SA, Mallet RJ, Hamilton DP, 2013. Cyanobacteria band testing: Examining applicability for the National (NZ) Objectives Framework. Environmental Research Institute Report No. 12. The University of Waikato, Hamilton. 28 pp.

and protecting human and animal health is needed in any NOF attribute associated with benthic cyanobacteria and subsequent management actions.

76. The cyanobacteria working group appointed by Ministry officials provided a recommendation that a numeric outcome for *Phormidium* (benthic cyanobacteria in rivers) should be included in the NOF. We recommend that this not be deferred because of potential for significant human and animal health issues. Research by various agencies and monitoring by regional councils at many rivers around New Zealand has resulted in extensive datasets (up to 5 years in duration) that provide adequate evidence for the development of NOF bands and for the inclusion of *Phormidium*-relevant criteria. **We recommend that the suggested values for *Phormidium* given by Wood and colleagues[19] are included in this iteration of the NOF (see table below) and that further analysis of existing data sets is undertaken to develop an appropriate and defendable 'banding statistic' either for future inclusion in any subsequent review of the NOF or, if time provides, in this iteration of the attribute tables.** There is adequate available data for work on the development of an appropriate banding statistic to be undertaken in a timely manner.

Value	Human Health (secondary contact)	
Freshwater Body Type	Rivers	
Attribute	Benthic *Phormidium* (cyanobacteria)	
Attribute Unit	Percentage cover	
Attribute State	**Numeric Attribute State**	**Narrative Attribute State**
	Further testing required	
A	All transects have less than 10% *Phormidium* cover	Contact with water poses no human health risk
B	All transects have less than 50% *Phormidium* cover	At certain times contact with river water poses a human health risk, and care may be required as extent of blooms increases
National Bottom Line	**80**	
D	Any one transect has more than 50% *Phormidium* cover	High human health risk

Estuaries

77. A combined meeting of the New Zealand Freshwater Sciences Society (NZFSS) and the New Zealand Marine Sciences Society (NZMSS) held in Hamilton last year identified a critical gap relating to research and management of estuaries. Estuaries are important: they are nurseries for fish; they filter out contaminants and are a 'hot spot' for wildlife and ecosystem services. Estuaries also lie at a critical point between land and sea where growing pressures from urbanisation, intensive lowland agriculture and rising sea levels collectively impact on their health and well-being. Examples include Tauranga and Porirua harbours which are adjacent to large population centres, and the New River Estuary in Southland which is being degraded by sediments and nutrients from agricultural sources.

78. Estuarine management will become increasingly important as the national Freshwater Reforms are implemented. Managing to limits may be extremely difficult to achieve in estuaries, which have traditionally acted as a sink for excessive levels of contamination arising from multiple inputs, sometimes across several catchments, nonetheless consideration of estuaries is urgently needed when setting freshwater limits. The NZFSS has publicly emphasised the need for a fully integrated approach to managing estuarine health, involving improved agricultural practice and better management of urban stormwater and wastewater, underpinned by inter-disciplinary research across the freshwater-marine space.

79. The NZFSS consider that, without urgent action, estuary health will be at severe risk from accelerated eutrophication, sedimentation and invasive species. The Society recommends that:

    - research and management be better coordinated among freshwater and marine scientists so that estuaries do not "fall between the cracks";

    - radical improvements be made to reduce sediment and nutrient loads to estuaries, particularly from areas of intensive lowland agriculture, but also from urban areas; and

    - **estuary numeric attributes are either included in the NOF or as a minimum estuaries are referred to specifically in the proposed policy amendments to the NPS FM as noted above.**

Lakes

80. **The NZFSS view the NOF identification of numeric attributes and bottom lines for Lake Ecosystem and Human Health as a positive step towards managing water quality to protect the values of lakes**. Members of the Society have reviewed the science panel report on Lakes[21] in relation to the NOF attributes and bands identified in Appendix 2 of the proposed NPS FM amendments. The narrative attribute descriptions are useful and the banding approach provides a reasonable description of ecosystem state of lakes in relation to the NOF numeric attribute states.

[21] Verberg P (2013) Classification and objective bands for monitored lakes. Prepared for Ministry for the Environment by the National Institute of Water and Atmospheric Research. 18 pages.

Primary contact recreation - lakes and rivers

81. Inclusion of NOF attributes only for secondary contact recreation is unlikely to safeguard people carrying out various recreational uses of lakes because activities in lakes are often focused around primary contact. This would include swimming, water skiing, and possibly kayaking. NOF attributes for recreation, including *E. coli* and planktonic cyanobacteria are required for primary contact recreation. This information is referred to in the science panel reports but not adopted in the final version of the NOF attributes tables (Appendix 2). Given the prevalence of water-borne diseases such as gastroenteritis, giardiasis, campylobacteriosis, cryptosporidiosis and others in New Zealand, the value of primary contact recreation in lakes should be compulsory in the NOF.

Value	**Human Health (primary contact)**	
Freshwater Body Type	Lakes and Rivers	
Attribute	*E. coli (Escherichia coli)*	
Attribute Unit	*E. coli*/100mL (number of E. coli per hundred millilitres)	
Attribute State	**Numeric Attribute State**	**Narrative Attribute State**
	95th percentile	
A	<130	very good
B	260	good
National Bottom Line	550	fair
D	>550	poor

Biological attributes for lakes

82. The NZFSS believe that like rivers, there is a lack of identified biological attributes in the NOF to reflect the ecosystem health value for lakes, even when attributes identified for future development of the NOF are considered. For example, lake aquatic macrophytes[22] are quite commonly monitored for assessing ecological

[22] http://www.niwa.co.nz/our-science/freshwater-and-estuaries/lakespi-keeping-tabs-on-lake-health

health of lakes around the country by regional authorities. However, these methods have not been identified in the proposed NOF attributes. Macrophyte communities are not only important as ecological health indicators, they also contribute to important ecological functions such as nutrient attenuation and providing key habitat for macroinvertebrate, fish, and taonga species. The Society requests macrophytes are an important area for future development of the NOF attributes and should be added to the table on page 21 of the discussion document. Where macrophytes are not present in turbid lowland lakes other indicators may need to be developed.

Lake classes and attribute bands

83. In the lake science panel document, there was consideration of different lake classes such as upland, lowland, and optically challenged lakes, that could help better classify the bands for some variables (e.g. total nitrogen or chlorophyll *a* as a proxy for phytoplankton biomass). The lack of reference to lake classes may present challenges in applying the banding nation-wide for all lakes or for defining appropriate national bottom lines across all lake classes; a 'one-size-fits-all' approach for lakes is overly simplistic. For instance it might be expected that lowland lakes would have different "reference" ranges (referred to in band A) to that of upland or alpine lakes. The ecological processes operating in shallow lakes where (1) nutrients from bottom sediments are can readily be recycled into the overlying water, and (2) where much or all of the water column is well-lit (i.e. within the euphotic zone), are often quite different from those found in deeper lakes, particularly those that stratify. Reference to a lake class could potentially provide more meaningful assignment of bands for protecting specific values, as well as defining reference ranges.

84. The currently proposed attributes for ecosystem health in lakes do not take account of the wide variety of lake types and environments that are commonly found in New Zealand. More work is needed to identify the criteria that apply to different lake types, particularly the chlorophyll *a* and nutrient bottom lines that apply to shallow lakes.

Wetlands

85. The NZFSS considers that wetlands should be explicitly included in the current discussion document and NPS FM amendments. The decision to delay the NOF for

wetlands is particularly concerning given the large extent and on-going loss of wetland habitat across New Zealand. On-going wetland loss and degradation is reported regularly by Regional Councils and freshwater scientists. For example, in Southland we have calculated that more than 1,000ha of wetland area has been lost in the last decade, principally due to agricultural intensification.

86. Because wetlands are not included in the NPS FM other than to reference their 'significant values' (Objective A2(b)) our ability to provide critical comment or review in the policy setting is limited. With so little area of wetlands left in New Zealand it can be argued that all remaining wetlands have a degree of significance (due to their national rarity). This has been reflected in the Environment Court decision[23] on the One Plan (Manawatu-Wanganui Region) which found in favour of rare and threatened habitat being deemed significant for a number of reasons, including "*the scarcity of wetlands*".

87. Similarly, wetlands which still have a water regime enabling them to be sustained will hold 'significant values'. The Society considers it would be helpful to consider other values, including: (1) a wetland condition index (using current national protocols for wetland monitoring), (2) the ratio of native to exotic plant abundance and (3) the abundance of transforming species (e.g. *Salix cinerea*).

88. Many potential numeric attributes related to wetlands for future inclusion in the NOF in 2016-2019 (e.g. Chlorophyll *a*, sediment, *E. coli*, heavy metals, organic contaminants and pathogens) are more relevant to the open water components of wetlands. In contrast, Soil total phosphorus and soil total nitrogen would apply to most wetlands, e.g., marsh, swamp, fen, bog, and pakihi/gumland. In the Society's view attributes that are more important and relevant are missing from this list. **We recommend the immediate inclusion of attributes for (1) wetland extent and (2) hydrological regime (water level) with bands based on wetland types in a similar manner to that recommended above for lakes[24].**

89. Wetland extent is the simplest way of measuring wetland health. Reduction of wetland extent will result in reduction of water volume contained within the wetland. Numeric attributes for bands can be developed based on the proportion of current area relative to historic extent (observed/expected wetland area). Wetlands

[23] *Day v Manawatu Whanganui Regional Council* Interim decision [2012] NZEnvC 182 para 3-39.
[24] Johnson P, Gerbeaux P 2004. *Wetland Types in New Zealand*. Department of Conservation, Wellington.

are identified in national and regional policy documents as of national importance but their extent is inconsistently monitored, despite reliable methods and tools to do so[25]. The inclusion of wetland extent as an attribute will provide the necessary national guidance on how best to protect remaining wetlands.

90. Hydrological regime (water level) is a critical factor to provide for wetlands. Simply put: without water there is no wetland. Hydrology is therefore the first consideration for identifying a set of attributes. Changes in water level regimes (e.g. drainage, regulated water flows) alter and degrade the essential habitat needs of flora and fauna (including habitat connectivity for migrating fish) which is recognised in the definition of ecosystem health. Numeric attributes for bands should be able to be developed for percentage changes in mean water level range (cm) for wetlands.

91. The Proposed National Environmental Standard on Ecological Flows and Water Levels recognised the key role of hydrology in maintaining wetland ecosystem function (and therefore health). This further reinforces our point.

92. The Society considers that the national values presented in the proposed amendments to the NPS FM apply to wetlands. For instance, in defining the Ecosystem Health value (in Appendix 1) the proposed amendments miss some important components of wetland functioning such as water fluctuation. We propose to add another value 'Ecosystem Services'. This attribute isbeing increasingly recognised at hearings for Regional Council plans. A useful list of ecosystem services relating to wetlands has been identified in the book chapter by Clarkson and colleagues[26]. Information on ecosystem services relating to other freshwater ecosystems is available in the same book publication[27].

Integration between NOF attributes for lakes and rivers

93. Apart from nitrate and ammonia toxicity, no other nutrient attributes have been proposed in the NOF to protect river ecosystem health. Nitrogen and phosphorus are widely recognised as key factors driving eutrophication in aquatic ecosystems.

[25] Leathwick JR, West D, Gerbeaux P, Kelly D, Robertson H, Brown D, Chadderton WL, Ausseil A-G (2010) Freshwater Ecosystem of New Zealand (FENZ) Geodatabase Version One - August 2010 user guide. Department of Conservation, New Zealand. 51 p.

[26] Clarkson BR, Ausseil AGE, Gerbeaux P (2013) Wetland ecosystem services In: Dymond JR *ed. Ecosystem services in New Zealand – conditions and trends.* Manaaki Whenua Press, Lincoln, New Zealand. Pp. 192–202.

[27] Dymond JR (2013) Ecosystem services in New Zealand – conditions and trends. Manaaki Whenua Press, Lincoln, New Zealand.

Primary and secondary effects of eutrophication are generally considered to be the major ecosystem health issues in New Zealand freshwaters. Both TN and TP are proposed indicators for lakes, yet in rivers the eutrophication potential of both N and P are ignored in the NOF.

94. There is a major disconnect in the NOF between the proposed nitrate bottom line for rivers (< 6900 µg NO_3-N/L) and the proposed nitrogen bottom line for lakes (< 800 µg TN/L). The bottom line for lakes is reasonable to safeguard ecosystem health in most instances – the nitrate bottom line for rivers is not. We suggest that TN and TP be given attribute status for rivers so that whole-catchment management can be more integrated in the NOF. At present, there are no linkages between attributes proposed for rivers and those proposed for lakes.

Microbiological water quality

95. The NZFSS **support** the approach of using a Quantitative Microbial Risk Assessment (QMRA) to identify risks associated with secondary contact recreation and informing the setting of national bottom lines for the Human Health value. However, we submit that **the *E. coli* bacteria attribute statistic to be used for measuring the state of a given water body against the bands should be expressed as the annual 95th percentile rather than the annual median** as is currently proposed in Appendix 2 of the NPS FM amendments.

96. The sample statistic used to compare against a band state or bottom line is very important and in this case influences the certainty and reliability of the reported risks to Human Health and thereby the descriptions of the narrative attribute state. The technical paper[28] highlighted the importance of this decision and suggested more detailed examination. The use of annual medians for comparing human health (secondary contact recreation) represents a higher risk approach than the more precautionary approach applied using the 95th percentile. This risk is not acknowledged or justified in the NPS FW discussion document or proposed amendments.

[28] McBride GB (2012) Issues in setting secondary contact recreation guidelines. Report to the National Objectives Science Panels, 9 September 2012, 12 p.

97. International good practice in public health matters is to take a precautionary approach such as applying a compliance rule using sample 95 percentile values[29]. This is consequently also the approach currently taken in the New Zealand microbial water quality guidelines[30] and used for reporting contact recreational risk nationwide. The approach taken in the proposed amendments to the NPS FW is inconsistent with good practice and the current NZ bathing water guidelines.

98. Using an annual median sample statistic to assess the state of a water body for secondary contact recreation means that there can be a high chance (up to 50%) that the risk stated in the document has been exceeded. For example, for a river that is just compliant with the national bottom line, there is up to 50% likelihood that real risk of infection is greater than the stated 5%. In contrast the bathing water guidelines are applied using a 95 percentile statistic; this means that there is a low chance that in such cases the real risk is greater than the nominal 5%. To put it another way, there is a lot less risk to your health to swim in a river that just meets the NZ bathing water guidelines for primary recreation than there is to fish a river that just meets the proposed secondary contact recreation bottom line.

99. The NZFSS submit that a precautionary approach to determining recreational safety is particularly important in the context of the NPS FW. The NPS FW allows for water bodies to be grouped into freshwater management units. Depending on how particular management units are defined it is possible that sites of different water quality are grouped together within the same management unit, which will further increase the chance that the real risk is greater than the reported risk for particular sites.

100. Lastly, we note that the proposed bottom line for secondary contact recreation (i.e. an annual median of 1000 *E. coli* /100 mL) is a lower standard than the commonly used secondary contact recreation guideline found in ANZECC (2000; i.e. a median of 1000 faecal coliforms /100 mL) thereby allowing worse water quality and greater risk to human health. *Escherichia coli* bacteria are a component of faecal coliform bacteria and so expressing the guideline as *E. coli* is always more lenient and sometimes considerably more lenient.

[29] World Health Organisation (2003) Guidelines for Safe Recreational Water Environments. Volume 1: Coastal and Fresh Waters. World Health Organization, Geneva. See especially Tables 4.7 and 4.12. http://www.who.int/water_sanitation_health/bathing/srwe1/en/

[30] MfE/MoH (2003). Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas. Ministry for the Environment and Ministry of Health, Wellington, New Zealand. http://www.mfe.govt.nz/publications/water/microbiological-quality-jun03/

101. **We strongly recommend altering the attribute statistic for *E. coli* in rivers and lakes from an annual median to an annual 95th percentile.** Failing that, the narrative attribute states for each of the bands will need to be altered to more transparently reflect the '50/50 (or even-handed)' level of risk to water users for secondary contact recreation purposes.

Monitoring, NeMAR and the proposed amendments to the NPS FM

102. It is clear that robust national level reporting, and the development and or refinement of essential ecological indicators for this purpose, requires information to be collected and analysed in a nationally consistent manner. The direction for regulatory bodies to undertake this task must be facilitated by central government with a direct link into NOF ecological indicator development.

103. National co-ordination is required because regulatory bodies will otherwise be unable to effectively report on the health of the nation's aquatic environment and refine the utility of important ecological indicators. Rectifying this situation is particularly important for fish as close to 50% of New Zealand's freshwater fauna are reliant on the ocean at some stage in their life-cycle and hence these species should be managed as national stocks. In effect for regulatory bodies to effectively manage and maintain these stocks regionally also requires information at the national scale. An example of this issue was recently highlighted by the Parliamentary Commissioner for the Environment (PCE) whereby the viability of New Zealand's endemic longfin eel fishery was debated before an independent international expert panel. Lack of nationally consistent data was identified as the principal issue hampering the panel from making an effective objective assessment.

104. It is presently unclear how initiatives such as the National Environmental Monitoring and Reporting (NEMAR) project and the National Objectives Framework (NOF) interact. NEMAR should run parallel to the NOF and should be structured to inform adaptive management of NOF limits for a range of attributes - including fish which provide important riverscape connectivity information.

105. The NZFSS supports the strengthening of the freshwater quality management system through science, research, knowledge and information transfer needed for water quality management. The Society considered that freshwater *must* be an integral component of at least one of the National Science Challenges. Funding of freshwater (and other environmental) sciences has declined in New Zealand over

many years. There are capacity and successional issues relating to these funding declines which will need to be addressed by the government in order to meet the information needed to fully implement the reforms. The current National Science Challenge 'Our Land and Water' needs to go beyond land productivity and also consider the current capacity issues as well as the ongoing degradation of New Zealand's freshwater ecosystems.

Conclusion and relief sought

106. The NZFSS strongly support amendments to the NPS FM that include the addition of a national objectives framework, values and national bottom lines for water quality.

107. The Society met jointly with the New Zealand Hydrological Society and Ministry for the Environment officials in December 2013 to discuss and review the work of the science panels and the final proposed numeric attributes. Much of this submission results from that discussion and peer review process. NZFSS members have thoroughly reviewed both the policy and technical proposals of the amended NPS FM and hope that the recommendations made through this submission are given adequate weight in the government's decision making process around the NPS FM amendments and NOF framework, given the level of experience and expertise across the Society's membership.

108. We trust that the information in this submission is useful and we are happy to engage further if required to clarify any points raised or provide any additional information needed. We value the opportunity to provide a review through the submission and feedback process. Our recommendations for changes to the proposed NPS FM amendments are highlighted in **bold** throughout the document.

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