

BEFORE THE PROPOSED NATURAL RESOURCES PLAN HEARINGS PANEL

IN THE MATTER of the Resource Management Act
AND

IN THE MATTER of water quality
AND

IN THE MATTER of Right of Reply evidence to matters
raised during Hearing Stream 4

**STATEMENT OF RIGHT OF REPLY EVIDENCE OF
MICHAEL GREER ON BEHALF OF WELLINGTON
REGIONAL COUNCIL**

TECHNICAL – IN REGARDS TO

- 1. Objectives for contact recreation (Objective O24)**
- 2. Objectives for aquatic ecosystem health (Objective O25)**

4 May 2018

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1. SUMMARY

1.1 My name is Michael John Crawshaw Greer.

1.2 I have been asked to provide technical evidence on the approach taken by the Wellington Regional Council (the Council) for objectives for fresh and coastal water quality in the Proposed Natural Resources Plan (the proposed Plan)

1.3 My key conclusions are:

- (a) For the most part, the conclusions made in my statement of primary evidence remain unchanged;
- (b) The current framework of Objective O25 represents a fair and appropriate mechanism of setting aquatic ecosystem health objectives for the Wellington Region until the Whaitua processes are complete;
- (c) Referencing the "*Technical guidance document: Aquatic ecosystem health and contact recreation outcomes in the Proposed Natural Resources Plan*" (Greenfield et al., 2015) in the footnotes of the proposed Plan to aid in the interpretation of the narrative outcomes in Tables 3.1, 3.2, 3.4 and 3.5 is appropriate, providing that more robust guidelines can be adopted upon their release;
- (d) A numeric outcome for benthic cyanobacteria should not be included in Tables 3.1 and 3.2 of the proposed Plan;
- (e) The term 'balanced' should not be deleted from the narrative outcomes in Table 3.4 and 3.5 of the proposed Plan;
- (f) The methodology used to classify rivers as "productive" in the proposed Plan should reflect the nationally accepted approach set out in the NPS-FM 2014;
- (g) The proposed Plan should set numeric outcomes for periphyton Weighted Composite Cover (periWCC) in Table 3.4;

- (h) The proposed Plan should set numeric fish Index of Biotic Integrity (IBI) outcomes. However, before a numeric outcome is included in the proposed Plan further technical work is required on the IBI to incorporate new fish monitoring data and re-define the existing IBI grading system so that it aligns with poor-fair-good-excellent system that forms the basis of other numeric outcomes in Table 3.4; and
- (i) The inclusion of the numeric NPS-FM attribute states for nutrients and phytoplankton as lake outcomes in Table 3.5 is not appropriate.

2. INTRODUCTION

- 2.1 My name is Michael John Crashaw Greer. I work for Aquanet Consulting Ltd as a Senior Freshwater Scientist.
- 2.2 I hold a PhD degree in Ecology and a Bachelor of Science in Zoology from the University of Otago. The title of my PhD is 'The effects of macrophyte control on freshwater fish communities and water quality in New Zealand streams'.
- 2.3 I have worked for local government, the Department of Conservation and NIWA. I have over 6 years of work experience in freshwater ecology. Since the 4th of March 2018, I have been employed by the Aquanet Consulting Ltd. Prior to that I was employed by the Greater Wellington Regional Council as a Senior Environmental Scientist.
- 2.4 I have read the Right of Reply: Water quality (water quality objectives and land and water policies) prepared by Rachel Pawson on the water quality provision in the proposed Plan.
- 2.5 My evidence relates to the approach taken by Council on the following specific matters:
 - (a) The development of objectives for contact recreation (Objective O24); and
 - (b) The development of objectives for aquatic ecosystem health (Objective O25).

3. CODE OF CONDUCT

- 3.1 I confirm that I have read the Code of Conduct for Expert Witnesses

contained in the Environment Court Practice Note and that I agree to comply with the code. My evidence in this statement is within my area of expertise. I have not omitted to consider material facts known to me that might alter to detract from the opinions which I express.

4. SCOPE

4.1 I have been asked to provide Right of Reply evidence on the following matters:

- (a) The risk of relying on the current outcomes in Tables 3.4 and 3.5 until the completion of the Whaitua processes;
- (b) The appropriateness of referring to the “*Technical guidance document: Aquatic ecosystem health and contact recreation outcomes in the Proposed Natural Resources Plan*” (Greenfield et al., 2015) in the footnotes of the proposed Plan to aid in the interpretation of the narrative outcomes in Tables 3.1, 3.2, 3.4 and 3.5;
- (c) The difference between primary contact recreation, secondary contact recreation and swimmability;
- (d) The appropriateness of including a numeric outcome for benthic cyanobacteria cover in Tables 3.1 and 3.2 as requested by submitters;
- (e) The appropriateness of deleting the term ‘balanced’ from the narrative outcomes in Table 3.4 and Table 3.5 as requested by submitters;
- (f) The appropriateness of the methodology set out in the proposed Plan for identifying productive rivers when assessing against the periphyton outcomes;
- (g) The appropriateness of including a numeric outcome for periphyton cover in Table 3.4 as requested by submitters;
- (h) The appropriateness of including a numeric outcome for fish IBI in Table 3.4 as requested by submitters; and

- (i) The appropriateness of including numeric outcomes for nutrients and phytoplankton in Table 3.5 as requested by submitters.

4.2 Although the options that I consider take into account submissions received on the proposed Plan, my conclusions are limited to technical matters and I do not provide recommendations on policy.

5. APPROPRIATENESS OF RELYING ON CURRENT OUTCOMES UNTIL THE COMPLETION OF THE WHAITUA PROCESSES

5.1 In my opinion the current framework of Objective O25 represents a fair and appropriate mechanism of setting aquatic ecosystem health objectives for the Wellington Region until the Whaitua processes are complete. Fish and Game (S308), the Royal Forest and Bird Protection Society and the Minister of Conservation (S75/027) have requested that 'drivers' of ecosystem health be included in Table 3.4 to ensure that the current biotic outcomes are met. Fish and Game (S308) have also requested that land use limits be set to meet the nutrient outcomes requested in their submission. While I agree that objectives for drivers and land use limits will be needed in the future to meet the biotic outcomes in Tables 3.4 and 3.5 of the proposed Plan, I do not agree with submitters that they should be set in this version of the Proposed Plan.

5.2 Setting relevant objectives for drivers and defining appropriate land use limits requires a deep understanding of the linkages between land-use, drivers, and aquatic ecosystem health. It is my opinion that there is currently insufficient technical information available to be able to fully understand these linkages, and that it is not appropriate to set land use limits and objectives for drivers now. Significant scientific investigations are being conducted as part of the Whaitua processes to ensure that the resulting land use limits and freshwater objectives are based on the best available science. Considering this, and the low risk of aquatic ecosystem health degrading between now and their completion (see para. 6.60 of my statement of primary evidence), it is my opinion that outcomes for attributes not currently included in Tables 3.4 and 3.5 of the proposed Plan and land use limits are best set through the Whaitua

processes.

- 5.3 During expert conferencing between Ms Kate McArthur (Minister for Conservation and Rangitāne o Wairarapa), Dr Adam Canning (Wellington Fish and Game Council), Professor Russell Death (Wellington Fish and Game Council) and myself, possible numeric outcomes for certain drivers were discussed. Agreement was not reached on whether numeric outcomes for drivers should be included in the proposed Plan and, as previously stated, it is my opinion that they should not be (see Section 1 of Joint Witness Statement and para. 6.57 of my statement of primary evidence). However, experts did agree on what the best available numeric outcomes for certain drivers would be, **should the panel decide to incorporate them into Table 3.4**. These agreed “best available” numerics are presented in Sections 2.10 to 2.14 of the Joint Witness Statement documenting the outcomes of the expert conferencing.

6. REFERENCE TO TECHNICAL GUIDANCE DOCUMENT IN FOOTNOTES TO TABLE 3.1, 3.2, 3.4 and 3.5

- 6.1 The GWRC report entitled “*Technical guidance document: Aquatic ecosystem health and contact recreation outcomes in the Proposed Natural Resources Plan*” (Greenfield et al., 2015) contains tables with suggested guidance on how to assess rivers and lakes against the narrative outcomes set out in Tables 3.1, 3.2, 3.4 and 3.5 in the proposed Plan until rigorous, defensible numeric outcomes are set.
- 6.2 In my opinion, referencing the guidance in Greenfield et al. (2015) in the footnotes of the proposed Plan to provide certainty during consenting processes is appropriate, providing that more robust guidelines can be adopted upon their release. The decision not to include the numbers set out in Greenfield et al. (2015) as numeric outcomes in the proposed Plan was made to allow for the use of more appropriate thresholds as they become available. Therefore, referencing Greenfield et al. (2015) in the footnotes of the proposed Plan without allowing for the uptake of future guidelines would be counterproductive.
- 6.3 The relationships between the guidance tables in Greenfield et al. (2015) and the tables in the proposed Plan are as follows:

- (a) Table 2.4 in Greenfield et al. (2015) provides guidance on how to assess rivers against the narrative outcomes in Table 3.4;
- (b) Table 2.7 in Greenfield et al. (2015) provides guidance on how to assess lakes against the narrative outcomes in Table 3.5; and
- (c) Table 3.3 in Greenfield et al. (2015) provides guidance on how to assess rivers and lakes against the narrative outcomes in Table 3.1 and 3.2.

7. DIFFERENCES BETWEEN PRIMARY CONTACT RECREATION, SECONDARY CONTACT RECREATION AND SWIMMABILITY

Primary contact recreation

- 7.1 Primary contact recreation encompasses those recreational activities where people's contact with freshwater is "likely to involve full immersion", or "a high incidence of ingestion or inhalation of water and water vapour such as swimming and kayaking" (from the NPS-FM 2011) (see para. 5.5 of my statement of primary evidence for further information).

Secondary contact recreation

- 7.2 Secondary contact recreation encompasses those recreational activities where peoples contact with freshwater "involves only occasional immersion and includes wading or boating (except boating where there is high likelihood of immersion)" (from the NPS-FM 2014) (see para. 5.5 of my statement of primary evidence for further information).

Swimmability

- 7.3 Put simply, 'swimmability' is a measure of how suitable a river or lake is for primary contact recreation. The term was first coined in the consultation document that set out the proposed 2017 Freshwater Reforms (Clean water: 90% of rivers and lakes swimmable by 2040), which included significant amendments to the *E.coli* attribute in the NPS-FM 2014. Prior to these amendments, the *E. coli* attribute states in the NPS-FM 2014 were set to provide various levels of protection for both secondary **and** primary contact recreation, but the national bottom line was set to protect for

secondary contact. The 2017 amendments shifted the focus of the NPS-FM 2014 *E. coli* attribute to ensuring that rivers and lakes are suitable for primary contact recreation, or are “swimmable”¹, more often. Accordingly, the attribute states were changed to provide different levels of protection for primary contact recreation only. The new attribute states effectively describe the ‘swimmability’ of a freshwater body with rivers and lakes below the C/D state attribute threshold considered ‘un-swimmable’¹.

7.4 Under the 2017 amended NPS-FM 2014 the median and 95th percentile *E. coli* concentrations and the proportion of samples above 540 and 260 cfu/100mL must all be considered when assessing rivers and lakes against the *E. coli* attribute states; the primary contact recreation outcome in the proposed Plan only considers the 95th percentile. However, analysis of SOE data for the Wellington Region suggests this single metric is generally more stringent than the four C/D attribute state thresholds in the 2017 amended NPS-FM 2014 combined, and that if a river meets the *E. coli* outcome for primary contact recreation in the proposed Plan, it will generally be ‘swimmable’ under the NPS-FM.

8. INCLUSION OF A NUMERIC OUTCOME FOR BENTHIC CYANOBACTERIA IN TABLE 3.1 AND 3.2

8.1 In their statements of primary evidence Ms McArthur and Professor Death recommended that a numeric benthic cyanobacteria outcome of <20% cover be included Table 3.1 and 3.2 of the proposed Plan. The outcome recommended by Ms McArthur and Professor Death aligns with the alert threshold in the “*New Zealand guidelines for managing cyanobacteria in recreational fresh waters – Interim guidelines*” (MfE/MoH, 2009). As stated in para. 5.32 and 5.35 of my statement of primary evidence, the MfE/MoH (2009) benthic cyanobacteria guidelines require significant refinement and are not appropriate for inclusion in the proposed Plan.

8.2 Since the release of the MfE/MoH (2009) interim guidelines in 2009, knowledge of benthic cyanobacteria has advanced significantly.

¹ The NPS-FM itself does not refer to ‘swimmable’ or ‘swimmability’ only the consultation document

Accordingly, the Ministry for the Environment, with the support of regional councils, has recently commissioned a team of researchers to review and update the guidelines. One of the possible updates to the guidelines is a shift from the coverage-based assessments currently used to assess the risk to human health, to toxicity-based assessments (Mark Heath pers. comm. 2018). The new guidelines will be released in late 2018 following a series of workshops, the first of which will be held on the 7th of May.

8.3 The Ministry for the Environment has also been working with a team of researchers, to develop a benthic cyanobacteria attribute for inclusion in the NPS-FM 2014. Research undertaken as part of the attribute development has advanced the understanding of benthic cyanobacteria toxin production and the risks to human health significantly. If a benthic cyanobacteria attribute is included in the National Objectives Framework, it is mostly likely to be toxicity based rather than coverage based (Mark Heath pers. comm. 2018).

8.4 Given the strong possibility that both the cyanobacteria guidelines and the NPS-FM attribute will be toxicity based rather than cover based, it is unwise, to incorporate the existing coverage based MfE/MoH (2009) guidelines in to the proposed Plan (Mark Heath pers. comm. 2018). It is important to note that even if future cyanobacteria guidelines remain cover based, they are likely to be significantly altered from what Ms Arthur and Professor Death have recommended for inclusion into the Proposed Plan.

9. DELETION OF THE TERM 'BALANCED' FROM THE NARRATIVE OUTCOMES IN TABLE 3.4 AND TABLE 3.5

9.1 In supplementary evidence presented to the hearing panel, the Minister for Conservation, Rangitāne o Wairarapa and the Wellington Fish and Game Council recommended that the narrative outcomes in Table 3.4 and 3.5 be amended so that the structure, composition and diversity of indigenous macrophyte and native fish communities are 'maintained', rather than 'balanced'. In my opinion this amendment is not appropriate. Native fish and indigenous macrophyte communities in many rivers and lakes in the Wellington Region are significantly degraded and maintaining them at their

current state will not achieve a 'good' or 'excellent level of ecosystem health, which is the aim of objective O25.

9.2 In her primary evidence Ms McArthur states that the term 'balanced', has no ecological context or meaning and should not be used in the narrative outcomes in Tables 3.4 and 3.5. I disagree. While balanced is a new term, I do not see that as a problem. An aspirational narrative outcome will always be subjective; if the desired state of an attribute could be described with certainty, a narrative outcome would not be necessary. Therefore, removing 'balanced' from the narrative outcomes in Table 3.4 and 3.5 will not make them easier to interpret and is, in my opinion, unnecessary.

10. AMENDING FOOTNOTE 7 UNDER TABLE 3.4 TO ALIGN THE PERIPHYTON OUTCOME ASSESSMENT METHODOLOGY WITH THE NPS-FM

10.1 In the notified version of the proposed Plan the prescribed methodology for assessing rivers against the periphyton biomass outcomes in Table 3.4 (Footnote 7) differs from that set out in Appendix 2 of the NPS-FM 2014. Specifically, the NPS-FM sets more stringent criteria for identifying 'productive' rivers than the proposed Plan (see para. 6.35 of my statement of primary evidence). This is important, as the periphyton biomass outcomes can be exceeded more frequently in 'productive' rivers (17% of samples) than in 'non-productive' rivers (8% of samples).

10.2 In her primary evidence Ms McArthur states that further work is needed to align the periphyton biomass assessment methodology with that prescribed in the NPS-FM (see para. 46 – para. 51). During expert conferencing between Ms McArthur, Dr Canning and myself, it was agreed that the methodology used to classify rivers as "productive" in the proposed Plan should reflect the nationally accepted approach set out in the NPS-FM 2014

10.3 Aligning the periphyton outcome assessment methodology in the proposed Plan with the NPS-FM 2014 would require amending the wording of Footnote 7 to incorporate the key components of Footnote 1 of the periphyton biomass attribute table in the NPS-FM 2014: An example is provided below.

- (a) “The periphyton objectives ~~for River classes 3,5 and 6 marked with an asterisk (*)~~ shall not be exceeded by more than 17% of samples in ‘productive’ rivers and; for all other River classes, to be exceeded and by no more than 8% of samples in all other rivers. based on a minimum of three years of monthly sampling. Rivers are categorised as productive according to types in the River Environment Classification (REC). Productive rivers are those that fall within the REC “Dry” Climate categories (i.e. Warm-Dry (WD) and Cool-Dry (CD)) and the REC Geology categories that have naturally high levels of nutrient enrichment due to their catchment geology (i.e. Soft-Sedimentary (SS), Volcanic Acidic (VA) and Volcanic Basic (VB)). Therefore, productive rivers are those that belong to the following REC defined types: WD/SS, WD/VB, WD/VA, CD/SS, CD/VB, CD/VA.”

11. INCLUSION OF THE PERIWCC AS A SECOND OUTCOME FOR PERIPHYTON IN TABLE 3.4

- 11.1 In her primary evidence Ms McArthur recommended that numeric outcomes for periphyton cover (measured as periphyton weighted composite cover (periWCC)) be included alongside the numeric biomass outcomes in Table 3.4. During expert conferencing between Ms McArthur, Dr Canning and myself it was agreed that the proposed Plan should indeed set numeric periWCC outcomes. The inclusion of periWCC in Table 3.4 would allow council to assess more rivers against the periphyton outcome than what they are currently able to do using the existing biomass outcome, as periphyton biomass is only monitored at ~13 SoE sites, while periphyton cover is monitored at all hard-bottomed sites.
- 11.2 Based on the guidelines recommended in (Matheson et al., 2012) a periWCC outcome of <20% is appropriate for rivers where the existing biomass outcome is <50 mg chl-a/m² and a periWCC outcome of <40% is appropriate for rivers where the existing biomass outcome is <120mg chl-a /m². Assessment against these outcomes should be based on the mean annual maximum periWCC (Fleur Matheson pers. comm. 2018)

11.3 It is important to note that periWCC and the biomass outcomes will not always reflect the same state, and at times some rivers may meet one outcome but not the other. If both periphyton cover and biomass data is available, rivers should be only assessed against the periphyton biomass outcomes to be consistent with the NPS-FM 2014.

12. INCLUSION OF THE IBI AS A NUMERIC OUTCOME FOR FISH IN TABLE 3.4

12.1 In her primary evidence Ms McArthur recommended that numeric outcomes for fish diversity (measured by the Index of Biotic Integrity (IBI)) be included in Table 3.4. During expert conferencing between Ms McArthur, Dr Canning and myself it was agreed that the proposed Plan should set numeric IBI outcomes, as a region specific IBI guidelines have been developed for Wellington (Joy, 2005)². However, before a numeric outcome is included in the proposed Plan further technical work is required on the IBI to incorporate new fish monitoring data (the existing Wellington IBI was developed in 2005) and re-define the existing IBI grading system so that it aligns with poor-fair-good-excellent system that forms the basis of other numeric outcomes in Table 3.4. I do not agree with the recommendation in Ms McArthur's statement of primary evidence that IBI outcomes should be set using the grading system in Joy (2005) (very poor, poor, fair, good, very good, excellent), as it is not compatible with process used to set other numeric outcomes in Table 3.4. Poor-fair-good-excellent type IBI grading systems have already been developed for other regions, including the Bay of Plenty and Waikato (Joy, 2005; Suren, 2016), and it is my opinion that one should be developed for the Wellington Region before numeric IBI outcomes are included in Table 3.4.

12.2 It is important to note that if a numeric IBI outcome is included in Table 3.4, the existing narrative outcome needs to be retained, as the IBI only considers diversity, and does not capture the resilience, composition or structure components of the current outcome.

² This contradicts statements made in para. 6.51 and 6.52 of my statement of primary evidence. I became aware of the Joy (2005) guidelines after my statement of primary evidence was presented to hearing commissioners in Hearing Stream 4.

13. ADDITION OF NUMERIC OUTCOMES FOR NUTRIENTS AND PHYTOPLANKTON IN TABLE 3.5

- 13.1 In my opinion the inclusion of the numeric NPS-FM attribute states for nutrients and phytoplankton as outcomes in Table 3.5 is not appropriate. To achieve the desired 'good' level of ecosystem health, the narrative outcomes for nutrients and phytoplankton should certainly aim to achieve the state described by the narratives for the relevant B attribute states in the NPS-FM 2014. However, the shallow nature of lakes in the Wellington Region means those narratives may be accomplished with less stringent numeric outcomes than what is prescribed in the NPS-FM 2014 (see para. 6.69 and para 6.79 of my statement of primary evidence). Consequently, future research is needed to set Wellington specific numeric outcomes for phytoplankton and nutrients that best reflect the narratives for the relevant B attribute states in the NPS-FM.
- 13.2 During expert conferencing between Ms McArthur, Dr Canning and myself, agreement was not reached on whether numeric outcomes for phytoplankton and nutrients should be included in Table 3.5 of the proposed Plan (see Section 2.7 of Joint Witness Statement). However, experts did agree on what the best available numeric outcomes for these attributes would be **should the panel decide that the narrative approach taken in Table 3.5 is not appropriate**. Consensus was reached that if numeric outcomes for phytoplankton and nutrients in lakes were to be included in Table 3.5, the B/C numeric attribute state thresholds for phytoplankton, total nitrogen and total phosphorous set out in the NPS-FM 2014 are the best currently available option, as in most lakes they represent a "good" level of ecosystem health on a poor-fair-good-excellent scale³. It is still my opinion that the NPS-FM 2014 numeric attribute states for phytoplankton, total nitrogen and total phosphorous may not be relevant in Wellingtons shallow lakes, and that numeric outcomes for these attributes should be set as part of the Whaitua processes. However, if numeric outcomes were to be included in

³ Fish and Game have requested that a TLI outcome of 3 be set for Lakes Wairarapa and Onoke (when closed), it was agreed that for this to be achieved total nitrogen, total phosphorus and phytoplankton outcomes would have to be set at the relevant A/B attribute state thresholds in the NPS-FM.

Table 3.5 of the proposed Plan, setting them below the NPS-FM B/C attribute thresholds without significant technical justification would be inconsistent with council's desire to achieve a 'good' level of ecosystem health.

14. REFERENCES

Greenfield, S., Milne, J., Perrie, A., Oliver, M., Tidswell, S., & Crisp, P. (2015). Technical guidance document: Aquatic ecosystem health and contact recreation outcomes in the Proposed Natural Resources Plan (Greater Wellington Regional Council Publication No. GW/ESCI-T-15/45) (p. 37). Wellington, New Zealand: Greater Wellington Regional Council.

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