

*under:* the Resource Management Act 1991

*in the matter of:* Submissions on chapters 6, 13 and 15 of the Proposed  
One Plan

*between:* **Fonterra Co-operative Group Limited**  
*Submitter*

*and:* **Manawatu-Wanganui Regional Council**  
*Respondent*

Statement of supplementary evidence of Dr Michael Robert Scarsbrook for  
Fonterra Co-operative Group Limited

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Dated: 17 February 2010

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**STATEMENT OF SUPPLEMENTARY EVIDENCE OF DR MICHAEL  
ROBERT SCARSBROOK FOR FONTERRA CO-OPERATIVE  
GROUP LIMITED**

**INTRODUCTION**

- 1 My full name is Michael Robert Scarsbrook and I have the qualifications and experience described in my Evidence in Chief (*EIC*). I repeat the confirmation given in that statement that I have read and agree to comply with the Code of Conduct for Expert Witnesses.
- 2 In this supplementary evidence I respond to the supplementary evidence of Drs Biggs, Quinn, Roygard, Mr McBride, and Mrs McArthur, who all appear as witnesses for the Manawatu-Wanganui Regional Council (*Horizons*).
- 3 The fact that this statement does not respond to every matter raised in the statement of witnesses relevant to my area of expertise, or every witness raising those matters, should not be taken as acceptance of the matters raised. Rather, I rely on my *EIC* in this statement to set out my opinion on what I consider are the key issues concerning water quality in this proceeding.

**RESPONSE TO MATTERS RAISED IN DR BIGGS' EVIDENCE**

- 4 Table 2 of Dr Biggs' supplementary evidence comments on a number of matters raised in my *EIC*.
- 5 Dr Biggs states that he disagrees with paragraph 23 of my *EIC*. It appears that Dr Biggs may have misunderstood paragraph 23 of my *EIC*, as I agree that it would not be appropriate to disregard the whole Proposed One Plan (*POP*) approach to setting water quality standards because a limited number of situations do not fit the framework. My point was that appropriate reference conditions standards be applied in situations where inequities between reference condition and "effects based" standards exist. This is further explained in paragraph 40 of my *EIC*.
- 6 In Table 2 of Dr Biggs' supplementary evidence, he states that he disagrees with paragraph 29 of my *EIC*. The point of my paragraph 29 was that there is a need to manage public expectations about the ability to control periphyton blooms. Nutrient-rich siltstones leach significantly higher levels of nutrients than some other rock types and this will set constraints on the level of algae control able to be effected in these catchments. This is not explicitly dealt with in the periphyton standards in the *POP*, because *Horizons* does not have the data to do this. This lack of information has lead to the inequities highlighted in the preceding paragraph.

- 7 Dr Biggs' explanation of his reason for disagreeing with my paragraph 30 suggests that he has misunderstood my evidence. I have not asserted that *"the primary driver for the MFE guidelines was protection of life supporting capacity"*. My evidence is that Horizons' officers have stated in evidence and during the hearings that many of the standards have been set to provide for life-supporting capacity. I stand by my statement that there is limited data to link periphyton biomass to ecosystem health in the Region. This is demonstrated in **Figure 1** below, which plots the Horizons data available to me at the time of preparing my evidence. A key limitation of this available data is that the periphyton data comes only from a single summer measurement of biomass repeated over a number of years (Ausseil & Clark 2007).
- 8 When presenting his evidence to the Panel, Dr Biggs commented on the "toxicity" of periphyton to invertebrate groups. In my view, this is incorrect. The negative correlation that often exists between periphyton biomass and invertebrate community health is driven by a complex set of often interrelated factors (e.g. summer temperature, levels of fine sediment, life cycles, successional changes and impacts of introduced predators such as trout). Indeed, there is published evidence of positive and negative correlations between periphyton biomass and invertebrate abundance and diversity, so to characterise the relationship between invertebrates and their periphyton food source as "toxic" is incorrect.
- 9 Dr Biggs' responses to paragraphs 32, 34, 37, 40 and 63 of my EIC are primarily differences of opinion. I understand that Dr Biggs does not disagree with my assessments, but only with the recommendations which flow from those assessments, including what those assessments mean for the validity of standards.
- 10 Dr Biggs disagrees with paragraph 36 of my EIC, in which I state that detailed information on nutrient and periphyton conditions across the Region's rivers is missing, and without it the imperative for strict regulatory controls on nitrogen leaching losses from intensive land use is weak. In response, Dr Biggs states that *"sufficient information is available... and there is no reason to suggest at present that the model does not apply to this Region"*. I understand that the model has not been calibrated for the Manawatu-Wanganui Region. In **Figure 1** below, I have plotted the relationships between N & P and periphyton biomass for data available from Horizons<sup>1</sup> and overlay the ranges of data used by Dr Biggs to generate his model (Biggs 2000). My point is that the model used by Dr Biggs may not be appropriate for use in the Manawatu-Wanganui Region, because nutrient concentrations and

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<sup>1</sup> Ausseil and Clark 2007.

periphyton biomass observed in the Region are very different from the dataset used to develop the original model.

- 11 A basic assumption within the model of Biggs (2000) and therefore within the POP, is that relationships between nutrient levels and periphyton over time at a particular site will mimic the relationships between average nutrient and periphyton conditions across a number of sites (i.e. sampling many sites around the country can substitute for detailed information over time at a particular site). Predictions made by Dr Biggs<sup>2</sup> are for an individual river. He suggests that, based on his model, there will be an up to 75% reduction in periphyton biomass following nutrient load reductions in the Manawatu River at Hopelands. This assumes that the nutrient levels at a site positively correlate with algae biomass at a site. This may not necessarily be the case. In Figure 2, I have plotted phytoplankton (algae suspended in the water column) biomass and nitrates in the Waikato River over a 20 year period (data provided by Environment Waikato). There is a significant negative relationship between nutrients and phytoplankton biomass, the causes of which are poorly understood. The key reason for showing this Waikato River data is to highlight the uncertain and complex nature of nutrient-periphyton interactions and highlight the uncertain outcomes should significant nutrient controls be attempted (i.e., controls on N-losses from the catchment may not lead to improvements in instream values).

#### RESPONSE TO MATTERS RAISED IN DR QUINN'S EVIDENCE

- 12 Dr Quinn's supplementary evidence appears to be focussed on addressing the comments made in my evidence that "*Horizons has provided no direct evidence of the relationship between nutrient concentrations and periphyton biomass*".<sup>3</sup> Dr Quinn's response is to agree that the information was not provided, but to disagree that there is no relationship. However, my EIC does not state that there is no relationship between periphyton biomass and nutrients. My comments are made to highlight that robust direct measurements are limited and instead Horizons has used a model that may, or may not, be appropriate for the purposes it is being used for.
- 13 There is weak evidence of a link between algal cover and nutrient concentrations based on the National River Water Quality Network (NRNQN). Table 3 of Dr Quinn's supplementary evidence shows correlation coefficients for the relationship between DRP, DIN (=SIN) and percentage cover of filamentous algae. When using average data (the most statistically appropriate dataset), there are seven data points. Relationships are not statistically significant at  $P < 0.05$  (most commonly applied criteria – Dr Quinn applies a less

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<sup>2</sup> Discussed in paragraph 63 of my EIC.

<sup>3</sup> See paragraph 33 of my EIC.

commonly used and more relaxed criteria of  $P < 0.10$ ). This weak relationship only serves to highlight my concerns about using modelled links between nutrient concentrations and periphyton biomass as the underlying driver for proposed changes to management of nonpoint source contaminants in POP. As noted above, Figure 1 below shows the relationships between periphyton biomass and nutrient concentrations in a selection of the Region's rivers. A linear regression of log-transformed data for both SIN and DRP shows statistically significant positive relationships between algae biomass and nutrient concentrations across sites. This was to be expected, although the variability in the data suggests the predictive power of these relationships is limited (i.e., we have a low level of certainty that changing levels of the independent variable (nutrient concentrations) will have the predicted effect on the dependent variable (periphyton biomass)).

#### **RESPONSE TO MATTERS RAISED IN MR MCBRIDE'S EVIDENCE**

- 14 I attended the hearing during the presentation of Mr McBride's evidence to the Panel. During that presentation, the Commissioners noted that merely because water quality trends are improving, does not mean Horizons should do nothing. I agree with this statement. The thrust of my EIC is that there is less of an imperative for the dramatic change in the management framework contained in the POP. Why move to a more costly nutrient management approach when the current management approach appears to be resulting in some improving water quality trends and no evidence of dramatic deterioration in the Region's water quality? Fonterra's position, explained in the evidence of Mr Sean Newland, is that an effective, but less costly, approach to regulation of nutrients should be adopted.<sup>4</sup>

#### **RESPONSE TO MATTERS RAISED IN MRS MCARTHUR'S EVIDENCE**

- 15 In Table 2 of her supplementary evidence, Mrs McArthur comments on a number of matters raised in my EIC. Where those comments repeat matters also raised by the specialist Horizons witnesses responded to above, I have not repeated my response to them.
- 16 Figures 8-11 in to Mrs McArthur's supplementary evidence show preliminary periphyton cover data for four sites (Manawatu at Weber Road, Manawatu at Hopelands, Manawatu downstream of the Pahiatua sewage treatment plant discharge, and Rangitikei at McKelvies). Mrs McArthur uses this data as evidence of the need to manage N&P year round, as high periphyton cover can occur year round.

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<sup>4</sup> Less costly than that proposed in the POP, but more costly than the situation prior to the POP.

- 17 I consider it inappropriate to use the percentage cover measure for these purposes. Measure of periphyton biomass (chl<sub>a</sub> mg m<sup>-2</sup>) would be the more appropriate measure to use. I am also unsure as to why the four sites displayed have been chosen, or whether they were a random selection of the 48 monitored sites. Quinn and Raaphorst (2009) assessed periphyton percentage cover at 73 NRWQN sites over the period 1990-2006. For the Manawatu River at Weber Road, NIWA field staff recorded a maximum percentage periphyton cover of 80% (based on 150 observations). In contrast, in just nine observation events, Horizons staff recorded two occasions when cover exceeded 80%. Visual assessment of periphyton cover can be influenced by a range of factors. As a result, visual assessment of periphyton cover is less reliable than quantitative measures of periphyton biomass.
- 18 In Table 2 of Mrs McArthur's supplementary evidence, she disagrees with my statement that there is limited information linking periphyton biomass and ecosystem health. I stand by my statement that Horizons lacks quantitative periphyton data from a range of sites over different seasons, and until it has this information, it cannot link nutrient concentrations, periphyton biomass and measures of ecosystem health across the Region. In my view, Horizons also needs to be very careful about assuming cause/effect relationships between nutrient concentrations and macroinvertebrates. Macroinvertebrates in streams flowing through agricultural catchments are faced with a wide range of often interrelated stressors (e.g. temperature, sediment, habitat destruction). Diagnosing the cause of any decline in ecosystem health (or what the relevant contribution of different stresses are) is difficult and is currently the focus of significant research in New Zealand to help understand the complex interactions of multiple stressors.
- 19 Mrs McArthur disagrees with my statements in paragraphs 32 and 68 of my EIC regarding nutrient limitations. In my view, where neither N nor P are limiting algal growth, it would make sense to focus management on the nutrient that is most easily controlled. This is often P, because it binds to sediment, which can be controlled through a range of well-recognised mitigation options (e.g. stock exclusion from waterways, stream fencing). If P loads to waterways are reduced, P may become limited. The additional benefit of this is increasing the N:P ratio, which can reduce the risk of favourable conditions for N-fixing cyanobacteria. In contrast, the focus of Rule 13.1 of the POP is N-control, with apparently less concern about P-control, particularly in intensively-farmed landscapes.
- 20 In Table 2 of Mrs McArthur's supplementary evidence, she disagrees with paragraphs 46, 53 and 54 of my EIC and states:

It is fundamentally flawed to suggest relationships between decreasing nutrient trends at the site scale and land use change at the regional scale, particularly in the absence of a robust analysis to determine the causes of improving trends.

- 21 I find this statement surprising given that this is exactly what Horizons is proposing to do in the POP. That is, through the POP rules and management regime, Horizons proposes to reduce nutrient loads by control of land use at the regional scale.

**DR ROYGARD**

- 22 In Table 2 of his supplementary evidence, Dr Roygard comments on a number of matters raised in my EIC.
- 23 Dr Roygard comments on my evidence that the number of reference sites for monitoring water management zones is insufficient.<sup>5</sup> My concern is not the *number* of sites monitored, but with how representative the picture of the Region's water quality is, based on those sites. If site choice is biased towards impacted sites, then the picture of water quality across the Region is also biased. For example, if Horizons had 30% of its waterways in native forest, but monitored a lesser percentage of such sites, then the network would not be regionally representative. Dr Roygard has not addressed my question contained within paragraph 72 of my EIC.
- 24 In response to paragraph 7.4 of my EIC, Dr Roygard states that combined information from both state and trends provides information for resource managers. I agree. However, when assessing the effectiveness of a particular management regime, in my view trends are more informative. The key point from my trend analysis is that there have been some improving trends and no deteriorating trends. In my view, this does not support Horizons' argument that current management approaches are not working in the Region and radical change with the imposition of strict controls of intensive agriculture is required.
- 25 I am unsure which aspect of my paragraph 44.2 Dr Roygard disagrees with in his Table. My EIC was that water quality league tables recently released by the Ministry for the Environment suggested that sediment and faecal contaminants in the Region's rivers should be a principal concern. In my view, sediment and faecal contaminants have far greater impact on community values than nutrients. This assertion was reinforced by supplementary evidence presented by Mrs McArthur (presentation to combined Water & Coastal Hearing panels on 11/12/09) in relation to levels of faecal indicator bacteria in coastal areas and their impacts on shellfish gathering.

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<sup>5</sup> Paragraph 72 of my EIC.

## CONCLUSION

26 I confirm the conclusions set out in my EIC.

Dr Michael Scarsbrook  
17 February 2010



Figure 1: Data on mean Chlorophyll *a* biomass and mean monthly nutrient concentrations (DRP & SIN) for 41 Manawatu-Whanganui sites (data obtained from Ausseil & Clark 2007). The blue boxes show the range of data values used by Biggs (2000; Table 1) to develop a model of periphyton biomass response to varying nutrient concentrations.

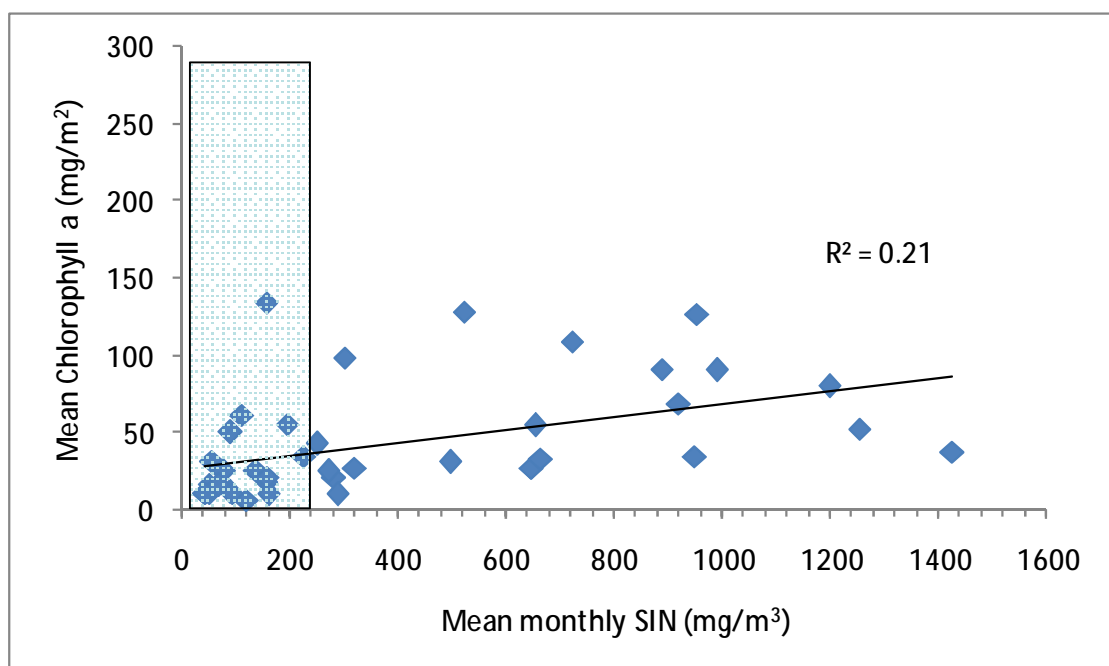
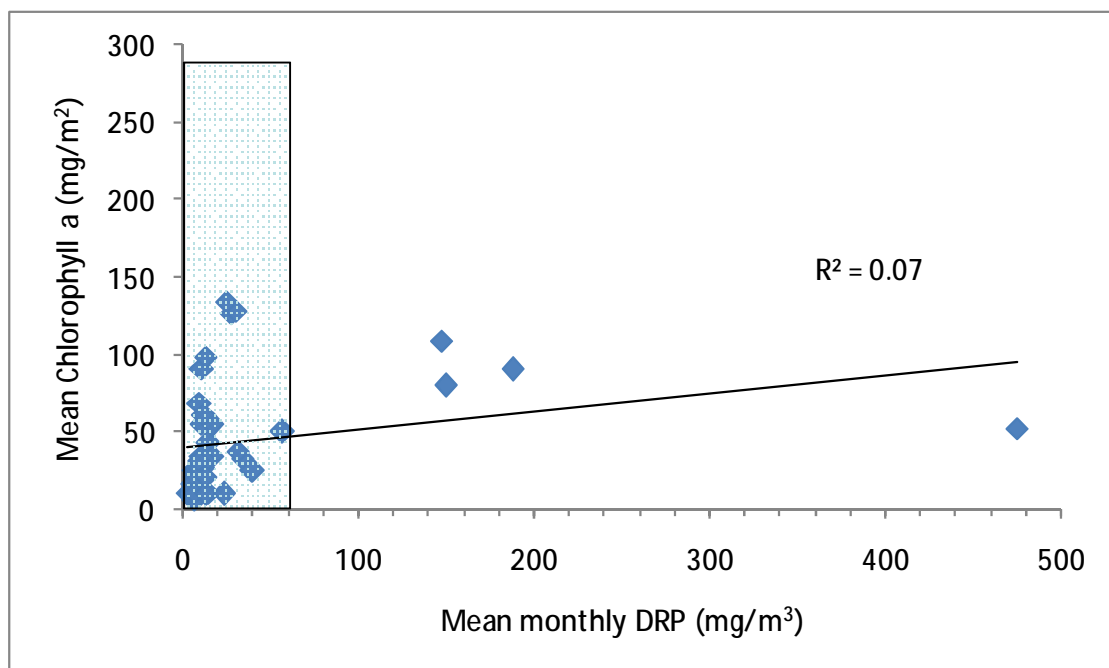


Figure 2. Scatterplot of monthly data (1987-2008) from the Waikato River at Narrows (data provided by Environment Waikato) showing the relationship between algal biomass (phytoplankton; mg/m<sup>3</sup>) and concentrations of nitrate/nitrite nitrogen (mg/m<sup>3</sup>). Linear regression shows a relatively strong relationship ( $R^2 = 0.33$ ) and a very highly significant negative slope to the relationship ( $P < 0.0001$ ).

