
in the matter of: the Resource Management Act 1991

and

in the matter of: a number of applications to take and use water from
the Upper Waitaki catchment

Addendum to brief of evidence of Antonius Hugh Snelder (on cumulative
water quality effects)

Dated: 30 November 2009

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ADDENDUM TO BRIEF OF EVIDENCE OF ANTONIUS HUGH SNELDER (ON CUMULATIVE WATER QUALITY EFFECTS)

INTRODUCTION

- 1 My full name is Antonius (Ton) Hugh Snelder.
- 2 My qualifications and experience are set out in the brief of evidence dated the 16 September 2009.
- 3 I have been engaged by Meridian Energy Limited (Meridian) to provide an addendum to my evidence dated the 16 September 2009 on the subject of the cumulative water quality assessment in response to caucusing that has occurred with experts engaged by Mackenzie Water Research Limited (MWRL) and Environment Canterbury (ECan) and in response to the supplementary evidence presented by MWRL.
- 4 I confirm that I have read the Environment Court's Code of Conduct for expert witnesses and this evidence has been prepared in accordance with that code. I agree to comply with the code's terms. In that regard, I confirm that the statements made in this evidence are within my area of expertise (unless I state otherwise) and I also confirm that I have not omitted to consider material facts which might alter the opinions stated in this evidence.

SCOPE OF ADDENDUM

- 5 In this addendum I outline:
 - 5.1 The outcome of three caucusing meetings I have attended with experts representing MWRL to discuss issues arising from the cumulative water quality assessment.
 - 5.2 Comments on rebuttal evidence presented by **Dr Coffey** and **Dr Ryder** for MWRL.

6 CAUCUSING

Caucusing meeting of 24 September 2009

- 6.1 On the 24th of September 2009 I attended a caucusing session with **Dr Coffey** and **Dr Ryder** on behalf of MWRL, **Dr Meredith** on behalf of ECan and my colleague **Ms Sutherland**. At this meeting I outlined the concerns that I have set out in my evidence in chief regarding the use of the Biggs (2000) periphyton biomass model and its lack of calibration for the streams and rivers of the Upper Waitaki Catchment. At that meeting **Dr Coffey** and **Dr Ryder** agreed that the cumulative water quality assessment placed a

strong reliance on the Biggs (2000) model and that more monitoring data would increase the certainty of the assessment.

- 6.2 We also discussed a lack of clarity in the cumulative water quality assessment reports. In particular it was not completely clear whether the stream nutrient concentrations that had been used to estimate periphyton biomass were modelled or measured concentrations. We reached agreement that greater clarity was needed around much of the cumulative water quality assessment. To my knowledge no additional information from MWRL has been forthcoming in response to these concerns.
- 6.3 A copy of the agreed minutes from this caucusing session are attached as **Annexure One** to this evidence.

Caucusing meeting of 15 October 2009

- 6.4 On the 15th of October 2009 I attended a caucusing session with **Dr Gamage, Dr Mzila, Mr Male, Dr Bright** and **Dr Robson** on behalf of MWRL and my colleague **Ms Sutherland**. At this meeting I again outlined my concern regarding the use of the Biggs (2000) periphyton biomass model and its lack of calibration for the streams and rivers of the Upper Waitaki Catchment. I raised the point that the annual maximum biomass is not the only aspect that should be considered and that increase in the duration of high biomass conditions in the Upper Waitaki Catchment should be in the assessment. To my knowledge no additional information from MWRL has been forthcoming in response to these concerns.
- 6.5 A copy of the agreed minutes from this caucusing session are attached as **Annexure Two** to this evidence.

Caucusing meeting of 11 November 2009

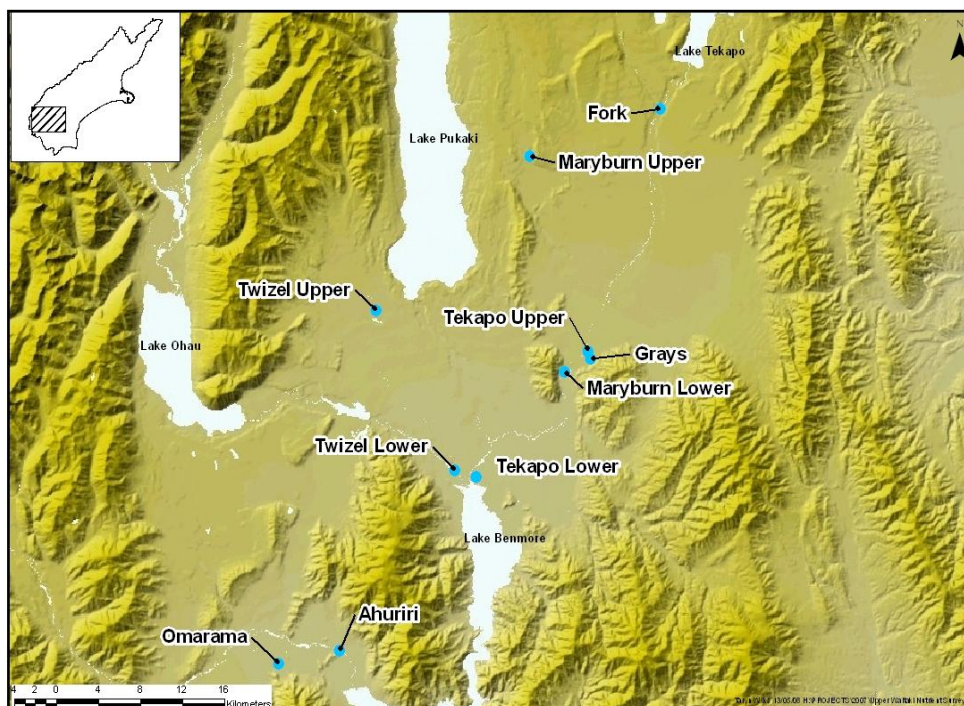
- 6.6 On the 11th of November 2009 I attended another caucusing sessions with **Dr Gamage** and **Dr Mzila** on behalf of MWRL, my colleague **Ms Sutherland** and **Dr Meredith** and **Mr Heller** on behalf of ECan. At this meeting it was confirmed by **Dr Mzila** that the stream and river concentrations on which the periphyton biomass estimates had been made were modelled rather than measured concentrations. This meeting was primarily concerned with the ground water modelling and there was no other topics discussed that directly concerned my evidence.
- 6.7 As far as I am aware, no agreed minutes of this meeting have been drafted.

7 REBUTAL EVIDENCE OF DR GREG RYDER

- 7.1 The rebuttal evidence of **Dr Ryder** on behalf of MWRL has concentrated on the river and stream health of the Upper Waitaki Catchment. Dr Ryder has used invertebrate indices based on data provided by ECan to assess the health of these systems. **Dr Ryder** asserts that the invertebrate data indicate that the streams and rivers of the Basin are “exhibiting signs of degradation on a number of occasions”.
- 7.2 Although it is not explicitly stated in **Dr Ryder’s** evidence, I assume that the importance of his assessment that streams in the Basin are degraded is that, if accepted, this would reduce the significance of impacts resulting from the irrigation development proposed by MWRL. I consider that this conclusion needs to be treated cautiously for two reasons.
- 7.3 First, it is my opinion that the invertebrate data do not indicate high levels of degradation. For 75% of samples the QMCI scores (a measure of stream water quality based on the whole invertebrate community) are greater than 5. QMCI values greater than 5 are indicative of “possible mild degradation” (Stark 1998). For 62% of the samples the QMCI scores presented by **Dr Ryder** are greater than 6, which is indicative of clean water (Stark 1998). From the data provided by **Dr Ryder**, only one sampling location (Wairepo Creek) consistently had QMCI scores of 3 or less indicating probable degradation.
- 7.4 The second reason I consider **Dr Ryder’s** assessment should be treated with caution is that in my evidence in chief, I presented actual periphyton biomass data that shows that streams in the basin have very good water quality, at least as indicated by periphyton. The location of the sites where the periphyton biomass measurements were made are shown in Figure 1 (below). Many of these sampling sites are consistent with the MWRL nodes. The actual measured periphyton biomass at all sites was well below the most lenient MfE Guideline values of 200 mg/m² chlorophyll *a*. In addition, 8 of the 10 sites were well below the strictest criteria of 50mg/m² chlorophyll *a*. I have confidence that these sampling occasions are likely to represent the annual maximum biomass because it occurred after three months of stable and decreasing flows in the Upper Waitaki Catchment (Figure 1 of my evidence in chief)..
- 7.5 MWRL nutrient load caps have been based on an assessment of periphyton biomass in terms of chlorophyll *a*, not invertebrates. However, no MWRL study that I am aware of has actually measured periphyton biomass in terms of chlorophyll *a*. MWRL’s cumulative water quality assessment of streams and rivers in the Basin is based on modelled mean annual maximum periphyton biomass (Table 14; Cumulative Water Quality Effects of Nutrients from Agricultural Intensification in the Upper Waitaki Catchment: Summary Report;

August 2009, prepared for Mackenzie Water Research Limited). These modelled results suggest that no stream nodes meet the MfE periphyton guideline for the protection of biodiversity of 50mg/m² chlorophyll *a*. Furthermore, the MWRL assessment asserts that only one stream node meets the most lenient MfE periphyton guideline values of 200mg/m² chlorophyll *a*. On this basis MWRL have proposed that the guidelines are too restrictive and should be relaxed. MWRL have suggested periphyton targets should be a further 25% above the modelled maximum annual biomasses. If accepted, this would allow periphyton targets to be set that are high relative to the guidelines with commensurately high nutrient concentration criteria. However, in my evidence in chief I describe why I consider that MWRL's assessment of maximum periphyton biomass is unreliable.

Figure 1 Sampling locations for periphyton biomass in the Upper Waitaki Basin . (source: Wilks and Norton In prep).



8 REBUTAL EVIDENCE OF DR BRIAN COFFEY

- 8.1 In his rebuttal evidence for MWRL, **Dr Coffey** suggests that the Biggs (2000) model is likely to overestimate periphyton biomass because the model does not account for invertebrate grazing (i.e. invertebrates consume the periphyton). **Dr Coffey** suggests that this is particularly likely in the streams and rivers of the Basin because they are hydraulically stable. I agree with this and in my evidence in chief I have suggested that this is possibly why the

assessment of periphyton biomass by MWRL does not produce periphyton biomasses that are consistent with the biomass that has been observed (Figure 2 of my evidence in chief).. The implication of this is that the nutrient concentration targets have been set based on overestimates of the existing periphyton biomass. That is to say, the nutrient loads will be set higher than they should be relative to the actual biomass that occurs.

- 8.2 **Dr Coffey** appears to be saying that the node concentrations proposed by MWRL would not result in the predicted biomasses because grazing has not been accounted for in the modelling and that this would provide a safety factor. This is however unlikely. Biological systems generally do not respond in a linear fashion. It is quite likely that an increase in the current periphyton growth rate would not be compensated for by a commensurate change in the invertebrate grazing. It is also likely that the periphyton community would change to filamentous green algae that are associated with visual and recreational impairment and that result in changes in the invertebrate community towards species that are tolerant of lower water quality. In my opinion, the lack of monitoring data describing the dynamics of periphyton in the Basin means that any assessment of the response of the systems to increased nutrients is highly uncertain.

9 **CONCLUSION**

- 9.1 Based on the rebutal evidence of **Dr Coffey** and **Dr Ryder** and the three caucusing meetings held with representatives of MWRL, the conclusions that I present in my evidence in chief are unchanged. It remains my opinion that the studies by MWRL do not establish with sufficient certainty the likely effects of land use intensification on the streams and rivers of the Upper Waitaki Basin or Lake Benmore. I do not resile from my recommendation that increased certainty will only be possible with the collection of more monitoring data that can be used to establish the responses of the streams, rivers, canals and lakes to nutrients.

Dated: 30 November 2009

Antonius Hugh Snelder

REFERENCES

Stark, J. D. 1998 SQMCI: a biotic index for freshwater macroinvertebrate coded-abundance data. *New Zealand Journal of Marine and Freshwater Research*, 27 (4) 55:66

ANNEXURE ONE: EXPERT CAUCUSING – 24 SEPTEMBER 2009

In attendance: Brian Coffey, Greg Ryder (MWRL): Ton Snelder, Donna Sutherland (MEL); Adrian Meredith (ECan)

Meeting started with Ton outlining Meridian's concerns with the technical work presented in the applicant's case. Ton stated Meridian was concerned that in due course it may come under pressure to provide flushing flows in the Tekapo and Ohau rivers if algal growths in them increase significantly. Meridian was also concerned with the implications of increased didymo, macrophytes, periphyton and phytoplankton growth in the canals and lakes to their operations.

Ton noted the GHD study was similar to the synoptic study NIWA undertook in 2005.

Ton expressed concerns with the calibration of the GHD modelling and the application of the Biggs 2000 chlorophyll *a* equations. Adrian noted that it was modelling based on modelled input data so had considerable uncertainty.

Brian considered that the estimates of periphyton biomass are over-estimates, although he stated he hadn't yet read the NIWA hearing evidence.

We all agreed that clarification of the biomass estimates and node nutrient limit targets were needed and that more monitoring/data would improve assessment of the model outputs.

Greg and Brian agreed that

- the applicant's case for periphyton biomass in rivers has a strong reliance on the Biggs model results and that little effort had gone into model verification.
- there was poor understanding of the relationship between the actual and modelled – water quality.
- there was poor clarity about the critical information in the applicant's reports.

We all agreed that there were key requirements

- More effective packaging what we currently have in order to increase clarity. Adrian suggested in particular a table that allowed comparison of modelled wq and periphyton biomass, and measured wq and periphyton biomass (as was presented as Table 1 in the NIWA sub-report of the GPF report in 2005) would allow more focused consideration.
- Working from the above, an assessment of the required information needs (monitoring) to increase confidence in estimates.

Adrian added that the applicant's reports also had a degree of confusion relating to habitat degradation under existing land use, and that that should not be confused with nutrient increase which may yet to be realised.

Information request

Brian – sought clarification from Adrian as to the source of information used to classify rivers in the upper Waitaki Catchment. Was this from an ECan database and was the accompanying water quality and ecological information available?

Adrian – Classifications were done at a fairly 'high level' as for the NRRP, and data are available.

Lakes

Donna outlined the Meridian evidence concerning Lake Benmore including:

The Ahuriri Arm last summer was found to be already in excess of TLI that MWRL propose.

There are discrepancies between MWRL and NIWA nutrient load data for both Arms

The applicants's reports miss-use the TLI, for example, not including chl a

The applicant's assessment of lake trophic status has serious shortcomings, for example, not considering in-lake processes, particularly for determining future nutrient loads.

The applicant's reports lack clarity around the use of the TLI. For example it is unclear if this is a never to be breached level or annual average or summer average.

Greg and Brian Coffey could not respond to this. They have had insufficient involvement in the lake work.

We all agreed that MWRL need to bring in their lake/WQ team to explain what they did and how they get the numbers they did.

Donna: Summer TLI in Ahuriri Arm is 2.9 existing – based on integrated sampling to 15 m.

We agreed we need greater clarity on figures – not much more that could be said.

Summary

We reached agreement that greater clarity is needed around much of the lakes and rivers work.

ANNEXURE TWO: LAKES EXPERT CAUCUS 15TH OCTOBER

Ton Snelder (TS), Donna Sutherland (DS) Nimal Gamage (NG) Doug Mzila (DM), John Male (JM), John Bright (JB) notes taken by Melissa Robson (MR)

Rivers

3 areas of concern – Data, model validation and appropriate thresholds

Data

There is a lack of clarity over what was modeled and what was measured (TS). It was noted that in terms of the river data there are clear indications of modelled information and measured data mean and range of data in the WQS summary report as well as data given in the appendix (MR).

The request for more clarification on data has already been received by GHD.

Model validation

1) Estimates of Chla at nodes are based on modelled nutrient loads and that this modeling from nutrient loads to Chla is essentially uncalibrated for the U.Waitaki (TS)

2) The use of the Biggs model may not necessarily be appropriate for the U.Waitaki (TS).

JB asked whether there was a subset of the Biggs' data that would be applicable. TS agreed to look but doubted it.

3) Concern that FRE3 was not enough of a flow to result in a flush (TS).

To address the points 1 and 2 above, at least 18 months worth of additional data (WQ and Chla) to build an empirical relationship between WQ and periphyton in the U.Waitaki specifically (TS).

Appropriate thresholds

Biggs model is based on max periphyton biomass, however the increase in duration over a particular threshold should also be considered.

TS requested that the stream periphyton biomass be modelled under the lake restriction (for the Ahuriri Arm).

Lakes

Ahuriri Arm was measured in the NIWA study to be at summer TLI of 2.9 (DS).

Haldon Arm was measured in NIWA study to have higher concentrations measurements than ECan and GHD (DS).

There was agreement that the Ahuriri Arm was more at risk than the Haldon Arm.

ECan monitoring results were dismissed (DS).

Wairepo Arm took summertime measured data from WQS and calculated TLI and found summertime TLI higher than annual average TLI quoted in WQS (DS).

Discussion between DS and NG whether the atypically high flows at the period of the NIWA study had affected the results. NG suggested that the high P loads measured were as a result of the atypically high flows during the sampling period. DS asserted that these flows and the data they yielded were representative No agreement on outcome.

NG asserted that Ahuriri Arm was very close to being N limited. DS asserted that mesocosm experiments showed co limitation. No agreement on outcome.

Principal concerns

- P load into the A arm
- Current TLI of lakes (Benmore and Wairepo)
- Loads entering Haldon Arm through canals
- Delta area of Haldon arm
- Lake processes are not included. DS asserted that under Oligotrophic conditions, that lake processes are more important than nutrient loading.
- Secchi depth not being included in the predictive modeling. Discussion between NG and DS regarding whether N and P alone could be used to predict TLI. NG asserted that CHLa and TLI was based on a straight line relationship in Oligotrophic and therefore could use N and P to predict. DS maintained that TLI has a biological component and should not be excluded. No agreement on outcome