Notes of meeting held at Environment Canterbury on 27 November 2009, 11 am – 1 pm, as a caucusing session to discuss the draft of Section 41C Report : Review of modelling approach used by NIWA to assist with assessment of effects of nutrient loads on water quality in Lake Benmore, by R Spigel, to be presented on 11 December 2009 the Hearing on Resource Consent Applications in the Waitaki Catchment (upstream of Waitaki Dam).

These notes were compiled by Clive Howard-Williams and Robert Spigel.

A draft of Dr Spigel's report was pre-circulated by Mike Freeman, by email on 24 and 26 November 2009, to: Gavin Kemble, Ewan Chapman, John Male, Kelvin Reid, Richard Turner

In attendance at meeting were: Ewan Chapman, Peter Glasson, Robert Spigel, Clive Howard-Williams, Gillian Ensor, Nimal Gamage (speaker phone), John Male (speaker phone).

Roughly the first half of the meeting was taken up with Dr Spigel summarising the main points of the report as written.

The remainder of the meeting was taken up with questions and comments from Dr Gamage, and responses from Dr Spigel with some additional comment by Dr Howard-Williams. A brief summary of Dr Gamage's comments and questions, and responses by Dr Spigel and Dr Howard-Williams, is given below.

Managing nutrient loads:
Dr Gamage commented that it is the applicants' intention to manage nutrient loads in a way that will maintain oligotrophic conditions in both Arms of the lake.

Calculation of the TLI:
Dr Gamage asked how the TLI was calculated for the Norton et al (2009) report prepared for ECan (referred to as N2009 in the remainder of the notes), as this was not clear from the report. Dr Spigel explained that after a model run, output from the model was post-processed to obtain statistics for average chlorophyll-a, TN and TP concentrations in the epilimnion, both over summer and for the entire year. These model statistics were then used to calculate the individual TLI scores for chlorophyll-a, TN and TP. The final TLI was calculated as the average of the three individual TLI scores. Dr Gamage said that it had not been clear from N2009 how, or if, chlorophyll-a had been included in the TLI calculation, and that this explanation helped to clarify that.

Nutrient attenuation in the lake:
Dr Gamage commented that because all nutrients, including those from groundwater, enter the lake in the model at the head of each arm, that these will be subject to some attenuation as they move through the lake to the outlet. What remains will be flushed from the lake. Dr Spigel replied that the model accounted for these processes.

Model nitrogen and phosphorus components:
Dr Spigel pointed out that the model calculations were based on individual inorganic and organic, dissolved and particulate components of nitrogen and phosphorus, rather than on total nitrogen (TN) or total phosphorus (TP). Chlorophyll-a calculations only used dissolved inorganic components. In the model there was some transfer (mineralisation) from organic components to dissolved inorganic components; there was some release of dissolved inorganic components to the sediments; and there was some loss of particulate components to the sediments and resuspension from sediments. There was no transfer from particulate inorganic components to dissolved inorganic components in the model configuration for the Benmore application. Hence for a value of TP that was made up mostly of particulate inorganic phosphorus, there would be very little effect on the chlorophyll-a calculation; only the fraction made up of dissolved reactive phosphorus (DRP) would have an effect.

Relative importance of internal load vs. external load:
"Internal load" refers here to dissolved inorganic nitrogen or phosphorus made available from mineralisation of organic matter and release from the sediments. Dr Gamage commented that the N2009 report seemed to imply that internal loading had a relatively small effect on chlorophyll-a, nitrogen and phosphorus concentrations in the model predictions. Dr Spigel agreed that he thought this was the case. Dr Spigel noted that the model parameters controlling mineralisation, loss to sediments and release from sediments were calibrated for the baseline runs and were not changed for the scenarios. Hence there was no attempt to increase the contributions from these processes in the scenarios. Also, the oxygen levels predicted near the sediments in all of the scenarios were never low enough to cause large releases of nitrogen and phosphorus from the sediments, and hence a shift to a regime where internal load could dominate the total load.

Dr Gamage said that he would like to have a quantitative estimate of the relative importance of internal load processes, compared with external loads, as predicted by the model. Dr Spigel replied that the model processes for internal load had been calibrated at baseline conditions so that the nitrogen and phosphorus concentrations predicted by the model were consistent with observed concentrations, but that no results were available from model output to quantify individual components of the nitrogen and phosphorus balances at a given point in the lake. Hence, while the model accounted for all these processes, Dr Spigel could not give detailed estimates for the components of the dynamic nutrient balances, but stated that it was possible to do so. To extract such results would require considerable effort [rerunning the model, specifying the location of a single point where the results were wanted, and analysis of output for all the relevant processes at that point].

Groundwater:
Dr Gamage commented that it might be helpful to rerun the model with different locations and depths for groundwater input. Dr Howard-Williams and Dr Spigel replied that this should be possible, as it was an option for model input, but this option had not been tested in the model runs done by NIWA.

Flushing vs. in-lake recycling:
Dr Gamage commented that he thought most nutrients introduced at the head of the lake were flushed from the lake at the dam, rather than being recycled within the lake

[this was Dr Spigel's and Dr Howard-Williams interpretation of the comments]. Dr Spigel and Dr Howard-Williams replied that the model accounted for nutrient uptake and recycling within the lake, but that we could not quantify the amounts flushed compared with that recycled in the lake.

Concluding remarks:

- Dr Gamage said he had no objection to submission of Dr Spigel's report.
- Dr Gamage said that it was unfortunate that he had not been able to attend the invited stakeholder workshops held by Environment Canterbury over the course of the model application and N2009 report preparation, as this would have clarified some issues and perhaps led to more consistency between the approaches taken by NIWA and GHD.
- Dr Gamage commented that while the meeting had helped clarify some issues, he considered that no progress had been made in resolving the differences between the GHD and NIWA approaches. He commented that he hoped a more cooperative approach could be arranged that would allow for direct collaboration between him and NIWA/University of Waikato modellers, in the hope that differences between nutrient load specifications could be resolved. Dr Spigel and Dr Howard-Williams agreed, and noted that this was the intention of the open workshop process during the development of this work.
- Dr Gamage reiterated that, regardless of the approach finally taken, it is the intention of the applicants to manage nutrient loads in a way that will maintain the oligotrophic state of Lake Benmore.

REFERENCE:

Norton, N., Spigel, B., Sutherland, D., Trolle, D., Plew, D. 2009. Lake Benmore Water Quality: a modelling method to assist with implementing nutrient water quality objectives. ENC09515; (CHC2009-091) Environment Canterbury. Appendices: Appendix A, Water quality parameters in the Upper Waitaki Basin December 2008 – April 2009; Appendix B, Nutrient addition experiments in the three main basins of Lake Benmore, April 2009; Appendix C, Model calibration and parameters; Appendix D, Representative year selection – climate and flow data; Appendix E, Nutrient load selection data; Appendix F, Lake Benmore model outputs for scenario year 2003-2004.