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 **Peter Francis Callander** (on cumulative water quality effects)

Dated: 30 November 2009

REFERENCE: JM Appleyard (jo.appleyard@chapmantripp.com)
BG Williams (ben.williams@chapmantripp.com)

Chapman Tripp
T: +64 3 353 4130
F: +64 3 365 4587

119 Armagh Street
PO Box 2510, Christchurch 8140
New Zealand

www.chapmantripp.com
Auckland, Wellington,
Christchurch

ADDENDUM TO BRIEF OF EVIDENCE OF PETER FRANCIS CALLANDER (ON CUMULATIVE WATER QUALITY EFFECTS)

INTRODUCTION

1 My full name is Peter Francis Callander.

2 My qualifications and experience are set out in the brief of evidence dated 16 September 2009.

3 I have been engaged by Meridian Energy Limited (Meridian) to provide an addendum to my evidence dated 16 September 2009 on groundwater issues 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.

5 Since the preparation of my original statement of evidence, I have attended caucusing with the MWRL experts on:

- 16th October 2009, attended by **Mr Bright**, **Mr McIndoe**, **Mr Male**, **Mr Mzila** (for MWRL) and **Mr Heller** and **Mr Hanson** (for ECan); and
- 28th October 2009, attended by **Mr Mzila** (for MWRL) and **Mr Heller** and **Mr Hanson** (for ECan).

HIGHLAND RECHARGE

6 In paragraphs 41-43 of my primary brief of evidence, I discussed discrepancies between the way in which the partitioning of the Highland Recharge was described in the text of MWRL Groundwater Report and in the tables of that report. During caucusing I have been provided with a spreadsheet that matches the partitioning of the Highland precipitation using the approach described in the text of the MWRL report. In paragraph 67 of his evidence, **Dr Mzila** comments that the difference between the two sets of numbers is less than 6%.

7 Whilst that might be the case, I am of the view, as with most of the groundwater analyses, that due to the absence of detailed field data this component of the water balance evaluation should be subject to a sensitivity analysis to consider the maximum and minimum potential range of groundwater recharge effects from the Highland areas. That level of more detailed assessment has not been carried out.

8 I consider that more detailed assessment would be useful because the Highland groundwater recharge makes a significant contribution to some of the surface waterways and therefore affects the consideration of whether or not some stream reaches are gaining from groundwater. Furthermore, the Highland deep groundwater recharge provides a significant dilution effect for the groundwater concentrations in some areas.

NITROGEN DRAINING TO GROUNDWATER

9 In paragraphs 56-58 of my primary brief of evidence, and in Figure 7 of that evidence, I describe the mass of nitrogen draining the groundwater under the MWRL scenarios, based on information from the MWRL reports. As a result of information obtained from **Dr Mzila** during caucusing, I have become aware that the numbers that I describe in my primary brief of evidence as the mass of N draining to groundwater do not represent all the soil drainage water that reaches groundwater. In a similar manner, paragraphs 64-69 and Figure 9 of my primary brief of evidence makes reference to the mass of N draining through the soil into groundwater and discharging from groundwater. Having seen the GHD spreadsheet, I now realise that the quantification of N entering groundwater, and discharging from it, that I described in my primary brief of evidence is not quite accurate. Therefore paragraphs 64 – 69 and Figure 9 of my main brief of evidence should be deleted. The GHD spreadsheet reveals that the numbers in the MWRL report do not include the soil drainage water that has been routed direct to surface waterways, some of which is removed by the denitrifying soil process and there is a more detailed movement of water and N between the groundwater and the rivers that was not presented in the MWRL reports.

10 The MWRL assessment has assumed that some of the N in the soil drainage water goes directly to surface waterways in areas where streams gain in surface flow. In reality, that drainage water must migrate to the stream via groundwater, but it has not been incorporated into their assessment of groundwater concentrations. I consider that is likely to be a conservative approach for the assessment of N concentrations in the streams and rivers, but not for the groundwater concentrations. By not including that N in the assessment of groundwater effects adds to the expectation that Policy WQN9 (1)(b)(iii)(l) of the proposed Natural Resources

Regional Plan (PNRRP) will not be met due to the increase in irrigated area.

11 I have not produced new versions of my Figure 7 and 9 from the spreadsheet I have been given, as the spreadsheet appears to contain some errors and inconsistencies in the calculation reference cells between different parts of the spreadsheet. However, I have taken the mass of N that drains through the soil and compared it with the mass of N that is listed in the GHD spreadsheet as discharging from each catchment in either groundwater or surface water. I have assumed that the discrepancy between soil drainage and the discharging mass have been removed by denitrification.

12 **Dr Mzila** and **Dr Bright** have reported that overall denitrifying soils remove 6-8% of the N. Whilst that might be correct for the entire basin, a review of data from the individual catchments shows a greater variability between the stream nodes. In particular, the following catchments have much higher proportions removed:

- Stony up to 22% removal;
- Quail Burn up to 15% removal;
- Omarama up to 25% removal;
- Hen Burn up to 20% removal.

At a more localised scale within these catchments, even greater removal rates have been assumed for some particular reaches. Therefore, at a more localised scale, the denitrifying soils are a significant and non-conservative factor in the assessment of some parts of the catchment.

13 In my initial interpretation of the MWRL information, I found the flow and mass balance charts in Appendix CC of the GHD Summary Report to be a useful guide. They appear to indicate that the groundwater (brown boxes) contributes to surface waterways that then flow into the arms of Lake Benmore. Through the caucusing discussions, I am now aware that the groundwater component (and most of the nitrogen lost from the soils) is assumed to go straight to Lake Benmore via a sub-surface pathway and does not enter the rivers and streams.

14 That partitioning of N between surface water and groundwater is based on a limited set of surface flow measurements and surface flow sampling, which creates a large degree of uncertainty in the analysis.

15 Based on the information from the caucusing, I consider that, from a groundwater perspective, the MWRL assessment have used a

reasonable approach to define long-term average effects. However, the reported output has a large degree of uncertainty because there is insufficient field data to be confident about the partitioning of flow and nutrients between the groundwater and surface water environments. Furthermore, the assessment does not define short-term (event related) or seasonal effects that might occur and impact on the rivers, streams and lakes.

16 The caucusing that we carried out produced no agreed statement from the experts and was more based on the MWRL experts providing an explanation of how they carried out their assessment – which was a level of understanding that could not be gained from their published reports. In regard to the GHD Toolkit spreadsheet, **Dr Mzila's** evidence reported a view that during the caucusing I agreed that the GHD methodology and toolkit was "robust and sound" (paragraph 71 of his evidence). That comment requires some clarification. At the caucusing meeting, I expressed my appreciation that **Dr Mzila** had provided us with the spreadsheet and given myself and the ECan experts an understanding of how the calculations had been carried out, which was not something that could be gained from the reports that had been published. I consider that the water balance and mass balance approach that has been used to consider the changes that might arise from increased irrigation to be a reasonable approach for this area. In that regard, the methodology is sound, although it has limitations in terms of what it can be used to define, i.e. only long-term average effects, not short-term variability.

17 However, I do not think that the output is robust, for two main reasons:

- firstly, there is insufficient field data to check the accuracy of the spreadsheet assessment; and

- secondly, the assumptions used in producing the output are not always conservative and no consideration has been given to the range of possible outcomes. For example:

  * the removal of nitrogen by denitrifying soils is not conservative;

  * the consideration of possible time delays for current land use effects on groundwater to develop is not conservative;

  * the addition of groundwater to gaining reaches of streams is likely to underestimate the N input from those sources because groundwater concentrations have been calculated on a bulk average basis whereas, in reality, shallower groundwater will have higher concentrations. It is this shallow groundwater that preferentially enters the streams.

18 **Dr Mzila** has indicated that the concerns I have expressed do not translate to significant differences in the final assessment of water quality, and I accept that might be a possible outcome if all the points that I have raised were resolved. However, until these matters are clarified, I cannot confirm that the output is robust and sound.

PHOSPHOROUS

19 Phosphorous has not been evaluated in the MWRL groundwater assessment. This is somewhat surprising, because in the MWRL Rivers and Lakes report, it is stated (on page 45), that "… *loss to ground and transport through groundwater is the most important factor*…" to describe the discrepancy between the OVERSEER output and the input of P to the rivers and streams.

20 During the caucusing, I was advised by **Dr Bright** that the loss of P from soils, as defined by OVERSEER, has been assumed to enter surface water, but has been scaled back to produce a load that matches the measured concentrations in rivers and streams. When it came to the assessment of water quality in the Haldon and Ahuriri Arms of Lake Benmore, the full mass of P estimated to be lost from the site soils has been included in the assessment, even though the migration pathway of this extra P is not defined.

21 I have been sent a further spreadsheet which reportedly contains MWRL's P assessment, however it is not self-explanatory and it has not been discussed at any of the caucusing meetings I have attended. Therefore, I cannot do the same evaluation that I have carried out for N. However, I have taken the mass of P reported in Appendix CC of the GHD Summary Report for each of the sub-catchments and compared them with the mass of P shown in the Lake analysis in Appendix BB of the GHD Summary Report. The results of this comparison are presented in Figure A.

22 Figure A shows that the assessment for the Haldon Arm is consistent with Dr Bright's description, with the Lake assessment having 15% (Scenarios 1 and 3) and 33% more P (Scenarios 2 and 4) than what has been defined as coming out of the surface waterways.

23 That is not the case for the Ahuriri Arm where the surface water contributions are the same as the mass used in the Lake assessment. However, the spreadsheet I have been sent has different numbers for P and a possible interpretation of that data is that the current scenarios have 6% more P in the Ahuriri Arm and 17% more P for the future irrigation scenarios.

MITIGATION ASSESSMENT

24 The spreadsheet that has been provided to us during caucusing does not include the effects of the mitigation measures that are required to meet the water quality targets. Therefore, it is unclear as to how these improvements have been defined within the individual sub-catchment areas.

CONCLUSION

25 My overall view from the information I have received since I prepared my original evidence is that the methodology used to carry out the assessment is reasonable for an assessment of long-term average groundwater related effects. However, it does not assess short-term or seasonal effects.

26 The reliability of the output from the assessment is uncertain, due to a lack of reliable or long-term field data, and some non-conservative judgements that have been made in the assessment. Furthermore, the explanations for the data I have been provided with are still not sufficient to fully check the output that has been produced.

27 The extra information I have received has not changed my overall conclusion and recommendation from my primary brief of evidence, which is:

- It would be prudent to carry out a detailed field monitoring programme over a 12 month period to better define thresholds and allowable limits for soil drainage discharges, and

- Ongoing groundwater monitoring is an essential requirement of any consents that are granted.

Dated: 30 November 2009

PETER FRANCIS CALLANDER