BEFORE THE INDEPENDENT COMMISSIONERS

IN THE MATTER	of the Resource Management Act 1991
AND	
	IN THE MATTER

REBUTTAL EVIDENCE OF ADAM DOUGLAS CANNING ON BEHALF OF THE NEW ZEALAND FISH AND GAME COUNCIL
21st of MAY 2015

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QUALIFICATIONS AND EXPERIENCE

1 My full name is Adam Douglas Canning. My qualifications and evidence were set out in my Evidence in Chief ("EiC"), dated 7th of May 2015.

2 In preparing this rebuttal evidence I have reviewed:

(a) The reports and statements of evidence of other experts giving evidence relevant to my area of expertise, including:

(i) EiC of Gregory Ian Ryder
(ii) EiC of Shirley Ann Hayward
(iii) EiC of Gerard Matthew Willis

3 I have again prepared this evidence in compliance with the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2011.

4 The particular points that I consider it useful for me to rebut are set out below.

EVIDENCE OF GREGORY IAN RYDER

5 Dr Ryder states in his evidence at paragraph 16:

> *"I consider the freshwater outcomes for the upper Hinds River are appropriate and achievable under the current plan provisions, with the exception of temperature"*

6 I do not agree with this statement and it is not clear what scientific grounds he used to support this conclusion. Whilst I agree that the QMCI values are suitable, as explained in my evidence, the proposed reductions in Nitrogen leaching will be far from sufficient to achieve life-supporting capacity. The proposed in-stream nitrate concentration limits are far too high and would cause periphyton to grow excessively and suffocate other aquatic wildlife. Furthermore, it is not enough to simply limit nitrate, as explained in my EiC, dissolved reactive phosphorus (DRP), suspended and deposited sediment, temperature, oxygen, periphyton, physical habitat, and riparian vegetation all also need to be managed to safeguard life supporting capacity.

7 I disagree with the claims that the maximum temperature limit is unattainable (paragraph 17), sufficient riparian vegetation cover can reduce in-stream water temperature considerably and within the maximum temperature threshold (Rutherford et al. 1997, Storey and Cowley 1997, Parkyn 2004, Collins et al. 2013). Furthermore, Rutherford et al (1997) suggests that 70% riparian cover will be sufficient to keep temperate streams below 70%. In my evidence I suggest that the temperature threshold should be lower at 19°C and have suggested higher levels of riparian shade. He also suggests that the occasional exceedance of temperatures will be *"relatively minor"* (paragraph 18). I also disagree with this claim. I am not aware of any scientific evidence that could support this statement. High temperatures can displace or kill many taxa thus drastically altering the community composition (Quinn et al. 1994, Huryn 1996, Palomares and Pauly 1998, Elliott and Hurley 2003, Piggott et al. 2012). Furthermore, high temperatures often do not occur just in a few places, rather many reaches across nearby regions experience high temperatures simultaneously, thus causing habitat squeezes to occur as there will be little viable habitat for affected taxa to seek refuge. Therefore recolonization from nearby reaches may take a considerable amount of time as those reaches may also lack affected taxa (Begon et al. 2006). Dr Ryder's evidence also states that many sites support healthy freshwater communities. I disagree with this, as in routine sampling data collected between 2008-2015 by ECan, less than one third of reaches sampled across the region had QMCI values greater than 6 – a value suggested as indicating a healthy freshwater ecosystem. Many of these sites were upland sites that rarely experienced high temperatures.

8 In paragraph 29, Dr Ryder discusses the need to manage nutrients for ecosystem health. I support his proposition that phosphorus be managed, but it needs to be accompanied by the management of nitrogen as well. It is not sufficient to allow high concentrations of one nutrient to persist whilst that of the other is kept at low concentrations. Freshwater ecosystems are extremely dynamic, the limiting nutrient can often change spatially and temporally, often differs between reaches in the same catchment, and different algae have different nutrient stoichiometry requirements. Limiting one nutrient whilst allowing the other to persist at high levels also means that periphyton will respond rapidly to even a small increase in the limiting nutrient. Furthermore, high nutrient concentrations impact on estuarine and coastal ecosystems and need to be minimised if eutrophication is to be prevented. The use

of Redfield Ratios in nutrient management has also been scientifically discredited (Francoeur 2001, Keck and Lepori 2012). In my opinion Variation 2 needs to contain a method that requires land management that meets specified in-stream limits on Dissolved Reactive Phosphorus (DRP). I propose the limits recommended in my evidence as being suitable limits to safeguard life supporting capacity.

9 I disagree with his claim in paragraph 32 that

> "*…extending the timeframe for nitrate toxicity limits/targets to be met by 2055 may have little meaningful ecological consequence.*"

10 Of 54 native fish taxa, as at 2013, 74% were considered as being at risk or threatened with extinction (Joy 2014). Furthermore, according to Dr Mike Joy (personal communication, 2015), the freshwater fish IBI is decreasing nationally at approximately 0.38/year which if continued will mean that all native freshwater fish species will be extinct by 2050 - and that's not including any Allee affects which may occur sooner (Joy 2009, Joy 2014). To that end, if limits to support ecosystem health are not met until 2055 then it is likely that by then there will be little biodiversity left to support. Once native freshwater fish are extinct, they will not be able to come back. Limits to safeguard life supporting capacity need to be met as soon as possible to provide suitable habitat for native freshwater fauna to thrive and prevent the decline of freshwater fish. Given that there is a lag between nutrients on land reaching waterways, I recommended in my Evidence in Chief that rapidly fencing and re-vegetating 80-90% of the catchment's riparian buffer zones will be necessary to achieve a healthy ecosystem as soon as possible and maintaining it over the long term. Vegetated riparian buffer zones absorb considerable amounts of nutrients before they enter waterways, reduce sediment erosion, lower in-stream temperature, limit Periphyton growth, provide alternative food supplies for freshwater taxa, and allow natural physical habitat character to exist.

11 In paragraphs 39 to 43 Dr Ryder recommends the use Targeted Stream Augmentation to achieve surface water quality and ecosystem health. However, as explained in my evidence, the nitrate concentration needs to be lowered 20-fold. To achieve desired levels by dilution with greater flows then flow rate would need to be 20 times higher than present rates. From my experience, this is extremely impractical

and would drastically alter the in-stream physical environment which would likely reduce the amount of suitable habitat available.

EVIDENCE OF SHIRLEY ANN HAYWARD

12 In paragraph 4.9, Ms Hayward states:

> "*I consider the level of protection set for the three surface water body types are appropriate as long term goals for those river types.*"

13 I am not aware of any scientific basis that could support this position and I strongly disagree with this statement. To begin with, the freshwater ecosystem needs to be managed for ecosystem health and not necessarily toxicity. Ecosystem health will long be reduced before high nutrients become lethal. The proposed values are very high and will mean excessive periphyton growth occurring (Biggs 2000). High periphyton biomass can cause large daily fluctuations in oxygen concentration, at low concentrations aquatic taxa will be suffocated (oxygen starved) to death, despite the majority of the day having sufficient oxygen concentration. This alters the entire community taxa composition. Using data collected all over Canterbury between 2008 and 2015, I modelled QMCI (a macroinvertebrate community index of ecosystem health) in response to a wide range of environmental variables (see my evidence in chief for more detail). Using Hinds River specific environmental variables, the model suggests that to achieve the desired QMCI values the upper and lower river needs to have a nitrate concentration limit between 0.1-0.3mg/L and DRP at 0.0004mg/L, and 0.5-0.7mg/L of nitrate and 0.006mg/L of DRP in the drains. These values are in line with those suggested in Gregory Burrell's evidence, as well as various peer-reviewed scientific studies (Hickey et al. 1999, Biggs 2000, Wagenhoff et al. 2011, Wagenhoff et al. 2012, Clapcott et al. 2014). Current nutrient concentrations are among the highest in the country and are 20-30 times higher than current in-stream concentrations.

14 At the end of paragraph 4.24, Ms Hayward refers to the reliance on Managed Aquifer Recharge (MAR) in achieving the target nitrate concentration. Whilst MAR can be used to decrease nitrate concentrations through dilution, there are a few caveats that need to be considered. For the MAR to be effective in diluting loads to achieve the desired concentration, then the water used needs to have a lower concentration than

the target concentration required to achieve ecosystem health, and be available in sufficient quantities. Furthermore, impacts of water loss from the site the water is sourced from needs to be considered. If a more appropriate shallow groundwater nitrate target is used to achieve ecosystem health (0.5mg/L for the Hinds River to 0.7mg/L for the hinds drains) down from 9.3mg/L then, given Dr Brown's recharge Overseer 6.2 values, MAR would need to be 53.5m^3/s, to dilute the high contaminant loads from land, which is an extremely large and unrealistic MAR.

15 Given the drainage volume as proposed by Dr Brown (using Overseer 6.2 and Aquainc), the leaching root zone loads in the lower Hinds catchment required to reach the shallow groundwater nitrate concentration of 0.5mg/L is 234.5 tonnes. That represents a 95% reduction in nitrate leaching required to reach a level which will safeguard aquatic life supporting capacity. With an annual MAR of 5m^3/s the nitrate leaching load would be 313 tonnes. Figure 1 shows just how easily shallow groundwater nitrate concentrations required for freshwater ecosystem health can be exceeded from high on-land nitrate leaching loads.

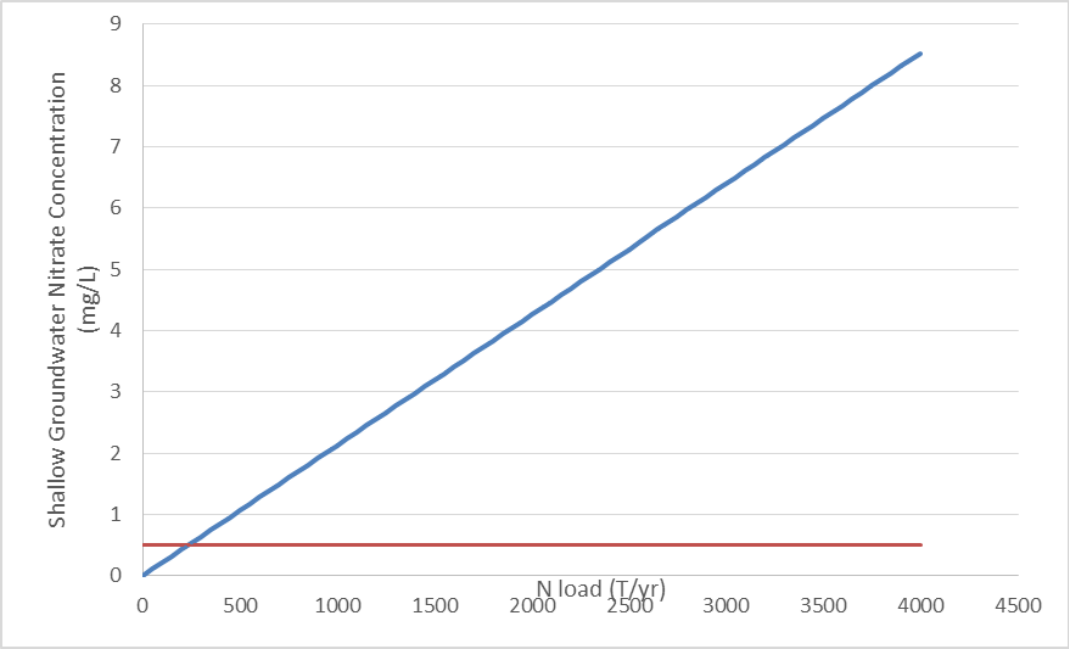


Figure 1. Lower Hinds catchment shallow ground water nitrate concentration (mg/L - blue) as a result of a given on-land nitrate load (tonnes) and a drainage of 469Mm^3. The required nitrate concentration is 0.5mg/L (red).

16 In paragraph 6.11 Ms Hayward modelled a "realistic irrigation development scenario" however, as stated above, not only does the water removal for irrigation impact the source site, but in terms of modelling, the nitrate loads carried by the irrigation water also need to be considered. Given that the ecosystem health of the Hinds River and

Hinds drains are currently significantly degraded, and that the leaching loads coming from the land are high, it is extremely risky to increase on land nitrogen leaching rates through further land use intensification and development, and unlikely to result in improvements in water quality and ecosystem health.

EVIDENCE OF GERARD MATTHEW WILLIS

17 In paragraph 7.2, Mr Willis gives his support for the proposed *"nitrate toxicity limits/targets for rivers."* Like Dr Ryder and Ms Hayward, no scientific evidence supports his claim. He cites Ms Hayward however as I have noted she provides no scientific evidence to support her position, and I am not aware of any that would. He also cites his understanding of the National Policy Statement on Freshwater Management, however this document is a policy document and does not contain any scientific study that could be used to inform or support his claim. As I explained above, the proposed nutrient limits are far too high to achieve ecosystem health.

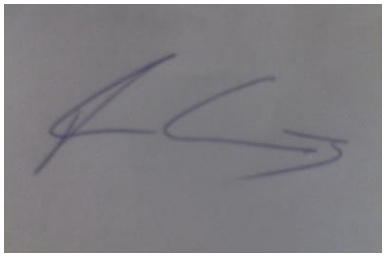
CONCLUSION

18 80-90% of the catchment's reaches need to be fenced off and re-vegetated as rapidly as possible to safeguard ecosystem health and buffer in-stream communities from on-land practices.

19 Both DIN and DRP need to be managed and limited to safeguard ecosystem health, not simply toxicity. The limits proposed in Variation 2 are far too high and need to 20-30 times lower to safeguard life supporting capacity.

20 Even with the drainage values provided by Overseer 6.2, nitrate load limits still need to be reduced by approximately 95% to meet in-stream nitrate concentration requirements to safeguard ecosystem health.

Adam Douglas Canning
Freshwater Ecologist
25th of May 2015



REFERENCES

Begon, M., C. R. Townsend, and J. L. Harper. 2006. Ecology: from individuals to ecosystems.

Biggs, B. J. 2000. Eutrophication of streams and rivers: dissolved nutrient-chlorophyll relationships for benthic algae. Journal of the North American Benthological Society **19**:17-31.

Clapcott, J. E., E. O. Goodwin, R. G. Young, and D. J. Kelly. 2014. A multimetric approach for predicting the ecological integrity of New Zealand streams. Knowl. Managt. Aquatic Ecosyst.:03.

Collins, K. E., C. Doscher, H. G. Rennie, and J. G. Ross. 2013. The effectiveness of riparian 'restoration'on water quality—a case study of lowland streams in Canterbury, New Zealand. Restoration Ecology **21**:40-48.

Elliott, J. and M. Hurley. 2003. Variation in the temperature preference and growth rate of individual fish reconciles differences between two growth models. Freshwater Biology **48**:1793-1798.

Francoeur, S. N. 2001. Meta-analysis of lotic nutrient amendment experiments: detecting and quantifying subtle responses. Journal of the North American Benthological Society **20**:358-368.

Hickey, C. W., L. A. Golding, M. L. Martin, and G. F. Croker. 1999. Chronic Toxicity of Ammonia to New Zealand Freshwater Invertebrates: A Mesocosm Study. Archives of Environmental Contamination and Toxicology **37**:338-351.

Huryn, D. 1996. Temperature-dependent growth and life cycle of Deleatidium (Ephemeroptera: Leptophlebiidae) in two high-country streams in New Zealand. Freshwater Biology **36**:351-361.

Joy, M. 2009. Temporal and Land-cover Trends in Freshwater Fish Communities in New Zealand's Rivers: An Analysis of Data from the New Zealand Freshwater Fish Database, 1970-2007. Ministry for the Environment.

Joy, M. K. 2014. New Zealand's freshwater disaster. New Zealand Science Review **71**:97.

Keck, F. and F. Lepori. 2012. Can we predict nutrient limitation in streams and rivers? Freshwater Biology **57**:1410-1421.

Palomares, M. L. D. and D. Pauly. 1998. Predicting food consumption of fish populations as functions of mortality, food type, morphometrics, temperature and salinity. Marine and Freshwater Research **49**:447-453.

Parkyn, S. 2004. Review of riparian buffer zone effectiveness. Ministry of Agriculture and Forestry, Wellington.

Piggott, J. J., K. Lange, C. R. Townsend, and C. D. Matthaei. 2012. Multiple stressors in agricultural streams: a mesocosm study of interactions among raised water temperature, sediment addition and nutrient enrichment. PloS one **7**:e49873.

Quinn, J. M., G. L. Steele, C. W. Hickey, and M. L. Vickers. 1994. Upper thermal tolerances of twelve New Zealand stream invertebrate species. New Zealand journal of marine and freshwater research **28**:391-397.

Rutherford, J. C., S. Blackett, C. Blackett, L. Saito, and R. J. Davies-Colley. 1997. Predicting the effects of shade on water temperature in small streams. New Zealand journal of marine and freshwater research **31**:707-721.

Storey, R. and D. Cowley. 1997. Recovery of three New Zealand rural streams as they pass through native forest remnants. Hydrobiologia **353**:63-76.

Wagenhoff, A., C. R. Townsend, and C. D. Matthaei. 2012. Macroinvertebrate responses along broad stressor gradients of deposited fine sediment and dissolved nutrients: a stream mesocosm experiment. Journal of Applied Ecology **49**:892-902.

Wagenhoff, A., C. R. Townsend, N. Phillips, and C. D. Matthaei. 2011. Subsidy-stress and multiple-stressor effects along gradients of deposited fine sediment and dissolved nutrients in a regional set of streams and rivers. Freshwater Biology **56**:1916-1936.