BEFORE THE HEARING PANEL

IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of application by Tararua District Council to Horizons Regional Council for application **APP-1993001253.02** for resource consents associated with the operation of the Pahiatua Wastewater Treatment Plant, including earthworks, a discharge to Town Creek (initially) then to the Mangatainoka River, a discharge to air (principally odour), and discharges to land via seepage, Julia Street, Pahiatua

**SUPPLEMENTARY EVIDENCE OF ADAM DOUGLAS CANNING (FRESHWATER ECOLOGY)
FOR THE WELLINGTON FISH AND GAME COUNCIL**

19 May 2017

1. My name is Adam Douglas Canning. I am a Freshwater Ecologist and my credentials are presented in my Evidence in Chief (EiC).

Response to questions asked to me by the commissioners in *Memorandum 3 To Participants (15 May 2017).*

2. "*In respect of Figure 1 on page 4 of Mr Canning's evidence:*

i) Whereabouts in the Mangatainoka River were the Figure 1 measurements made?

ii) If that is the type of pattern that might be caused by the Pahiatua WWTP discharge, how far downstream might it extend?"

i) The diurnal dissolved oxygen fluctuations depicted in Figure 1 were made above shortly above the confluence with the Makakahi River (40˚28'36"S, 175˚47'14"N) (Wood *et al.*, 2015). Therefore, the readings are well above, and consequently unaffected by, the Pahiatua Wastewater Treatment Plant (WWTP). The readings should not be taken as depicting the impact of the WWTP. Rather they show that a) the Mangatainoka River is in poor ecological health well before the WWTP; b) that extreme diurnal fluctuations in dissolved oxygen can and do occur in the Mangatainoka River; and c) increased nutrient inputs by the WWTP would likely exacerbate existing diurnal fluctuations and further reduce ecological health (as explained in my EiC).

ii) Given that the pattern is observed upstream of the WWTP, I am confident that the pattern will also exist downstream as water quality deteriorates. The Mangatainoka River flows into the Tiraumea River which then shortly flows into the Manawatu River. All of these river reaches are unlikely to be sufficiently aerated to dampen large diurnal oxygen fluctuations and prevent the ecological communities from being disturbed. Furthermore, in the Manawatu River at the Hopelands Road monitoring site (upstream of the Tiraumea River confluence), continuous monitoring of dissolved oxygen revealed levels swinging between 40% and 140% over 24hrs in late summer (Clapcott and Young, 2009). Therefore, high nutrient loads resulting in oxygen fluctuations in the Mangatainoka River will likely exacerbate existing fluctuations in the downstream Manawatu River. Unfortunately, I cannot provide an exact distance downstream that the impact would last for as in most situations a river responds to the incremental impacts of many inputs and in-stream processing is difficult to measure. Though the removal of nutrients from rivers by ecological communities to the atmosphere is typically small so nutrients can travel and consequently disturb communities over large distances.

3. *"Mr Canning makes two differing statements about the effects of nutrients on periphyton growth:*

   i) At the end of paragraph 7a Mr Canning's evidence agrees with Dr Ausseil that periphyton in the Mangatainoka River is likely to be phosphorus limited.

   ii) In paragraphs 7dii and 7fiv the evidence says that both SIN and DRP must be reduced to very low concentrations to achieve the One Plan MCI target.

   Based on those comments, what is Mr Canning's view of the effect on periphyton growth arising from TDCs proposed reduction in phosphorus concentrations in the WWTP discharge, assuming that the current effects from land use and other discharges continue as they are now? i.e. will there be a beneficial improvement in the periphyton situation?"

At a <u>particular point in time</u>, periphyton growth may be phosphorus-limited, nitrogen-limited or co-limited. To illustrate by metaphor, periphyton growth is akin to building a house, with a limiting nutrient being analogous to having no more bricks or mortar. The builder may have plenty of bricks, but without sufficient mortar they are unable to continue works – they construction is said to be mortar-limited. However, if mortar is then made freely available then building can continue until the next resource becomes limiting. When periphyton becomes limited by phosphorus then it only remains limiting until such time that more phosphorus becomes available (likewise with nitrogen). A river's flow, temperature, pH and nutrient fluxes can easily switch a DRP limited river to a DIN limited river by releasing sediment-bound phosphorus, and vice versa (Briand, 1983; Wilcock et al., 2007). Also, different algae species thrive in and are composed of different N:P ratios (B. J. Biggs, 1990; B. J. F. Biggs & Price, 1987; Milner, 1953); therefore, changes in algal community composition (which can occur for a variety of natural and unnatural reasons) may respond differently to different N and P ratios (or akin to a different house design that may not need as much mortar). Furthermore, two reviews of an extensive array of studies (237 and 382 studies, respectively) have found Redfield ratios (the molar N:P ratio) are inaccurate for determining nutrient limitation (Francoeur, 2001, Keck and Lepori, 2012). Whilst, the Mangatainoka River is currently likely to be phosphorus-limited, this may not always be the case (for the reasons explained above). It is for these reasons that I consider it necessary to manage both nitrogen and phosphorus.

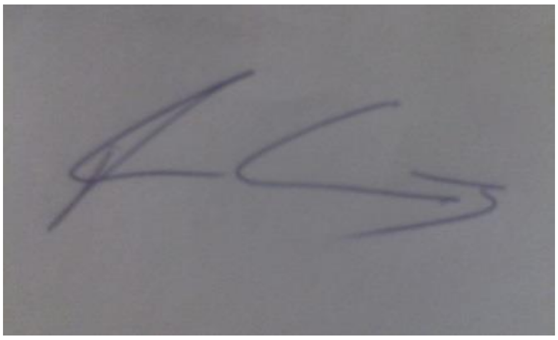
According to the applicant's document *Pahiatua Waste Water Treatment Plant Discharge of Treated Wastewater* authored by Opus (2015), on page 12 they state "Very small improvements could be expected to the TN and TP levels." I, therefore, consider the applicants proposal to have minimal beneficial improvement in periphyton – that is, the upgrades are unlikely to result in considerable reductions in periphyton biomass. Furthermore, in the applicant's *Response to Section 92 Further Information Request – Pahiatua Wastewater Treatment Plant* document by Opus (2017) they provided potential in-river concentration increases, which I have assumed include the potential improvements from their proposed upgrades. It is these values that I used in my EiC paragraphs 7g(i-iii) to calculate the likely contribution of phosphorus to in-stream concentrations of desired limits.

In direct response to the question, I do not consider the applicant's current proposal sufficient to reduce periphyton biomass downstream. On the provision that flow regimes, temperature, pH and nutrient fluxes remained the same, if the proposal were to change (from its current form) in a way that substantially reduces phosphorus loading (especially during low flows), then substantial reductions in periphyton biomass could also be expected (especially during low flows). One possible way to improve phosphorus loading at key times would be to have land-based discharge during summer months as soil binds to phosphorus and plants uptake phosphorus, though a suitably qualified WWTP engineer may also suggest alternative avenues for further reducing phosphorus loads.

Adam Douglas Canning

Freshwater Ecologist

19th of May 2017



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3. Keck, F. & Lepori, F. 2012. Can we predict nutrient limitation in streams and rivers? *Freshwater Biology,* 57**,** 1410-1421. Available: DOI 10.1111/j.1365-2427.2012.02802.x.
4. Wood, S. A., Depree, C., Brown, L., Mcallister, T. & Hawes, I. 2015. Entrapped Sediments as a Source of Phosphorus in Epilithic Cyanobacterial Proliferations in Low Nutrient Rivers. *PLOS ONE,* 10**,** e0141063. Available: DOI 10.1371/journal.pone.0141063.