

## REPLY STATEMENT OF DR JAMIE MACKAY IN RELATION TO APPLICATION FOR RESOURCE CONSENT

1. I confirm that I am a Senior Ecologist at Wildland Consultants Ltd, an ecological consultancy company specialising in ecological assessments, ecological restoration, ecological surveys and monitoring, and ecological research. This statement is produced in addition to my statement of evidence tabled at the hearing of this matter in Taipa on 24-26 June 2019. The purpose of this evidence is to address matters arising during the hearing for the purposes of the applicant's right of reply.

### CHEMICAL FORMS OF AMMONIA REFERRED TO IN MY EVIDENCE

2. The following extract is from Section 8.3.7 of the ANZECC & ARMCANZ (2000)<sup>1</sup> guidelines:

*The term 'ammonia' refers to two chemical species of ammonia that are in equilibrium in water: the unionised ammonia, NH<sub>3</sub>, and the ionised ammonium ion NH<sub>4</sub><sup>+</sup>. The proportion of the two chemical forms in water varies with the physico-chemical properties of the water, particularly pH and temperature.*

3. I acknowledge that ammonia concentrations reported in my evidence did not distinguish between unionised ammonia (NH<sub>3</sub>), the ionised ammonium ion (NH<sub>4</sub><sup>+</sup>), and ammoniacal-nitrogen (NH<sub>4</sub>-N). Ammonia concentration measured at the WWTP discharge compliance point is expressed as ammoniacal nitrogen (NH<sub>4</sub>-N). Ammonia concentrations that cause acute toxicity in fish as measured by Richardson (1997)<sup>2</sup> are expressed as concentration of unionised ammonia. The toxicity of ammonia to aquatic life is primarily attributed to unionised ammonia as this molecule is able to cross epithelial membranes more readily than ionised ammonium.

### CHRONIC FIGURES OF AMMONIA EXPOSURE

4. Chronic effects of ammonia can include a reduction in hatching success, reduction in growth rate and morphological development, and pathological changes in gill, liver, and kidney tissue (ANZECC & ARMCANZ, 2000).

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<sup>1</sup> Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra.

<sup>2</sup> Richardson J. 1997: Acute ammonia toxicity for eight New Zealand indigenous freshwater species. *New Zealand Journal of Marine and Freshwater Research* 31(2): 185-190.

5. To the best of my knowledge, there have been no investigations into chronic ammonia toxicity concentrations for freshwater fish in New Zealand. Hickey *et al.* (1999)<sup>3</sup> investigated the chronic toxicity of ammonia to New Zealand freshwater invertebrates; however, the full text of the article is behind a paywall and I do not have access to the journal. Their abstract reports a 29 day EC<sub>50</sub> (acutely toxic concentration) at pH 8.4 for *Deleatidium* sp. mayfly of 0.145 mg/L unionised ammonia.

#### **COMPARISON OF FRESHWATER ATTRIBUTES OF RICHARDSON (1997) AND THE NATIONAL POLICY STATEMENT FOR FRESHWATER MANAGEMENT (2014)**

6. The National Policy Statement for Freshwater Management (2017)<sup>4</sup> sets a National Bottom Line Annual Median concentration for total ammoniacal nitrogen of 1.30 mg/L, and an Annual Maximum concentration of 2.20 mg/L at pH 8 and a temperature of 20 °C. These values equate to 0.05 and 0.08 mg/L unionised ammonia at pH 8 and a temperature of 20 °C, respectively<sup>5</sup>. The Narrative Attribute State for the National Bottom Line is “80% species protection level: starts impacting regularly on the 20% most sensitive species (reduced survival of most sensitive species)”.
7. The Recommended Conditions of Consent provided by Northland Regional Council dated 2 July 2019 require an annual median ammoniacal nitrogen concentration of no more than 10 grams per cubic metre based on pH 8. This is equivalent to 0.382 mg/L of unionised ammonia at pH 8 and a temperature of 20 °C.
8. The LC50 (concentration lethal to 50% of test organisms) concentrations over 96 hours (as per Richardson 1997) for the indigenous freshwater fish species recorded in the WWTP discharge channel (inanga, common bully, longfin eel, shortfin eel) range from 0.86 to 2.35 mg/L of unionised ammonia.

Dated 15 July 2019



Dr Jamie MacKay

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<sup>3</sup> Hickey, C.W., Golding, L.A., Martin, M.L. and Croker, G.F., 1999. Chronic toxicity of ammonia to New Zealand freshwater invertebrates: a mesocosm study. *Archives of environmental contamination and toxicology*, 37(3), pp.338-351.

<sup>4</sup>National policy statement for freshwater management 2017. Ministry for the Environment.

<sup>5</sup> Calculated using an online calculator <https://www.svl.net/2016/01/unionized-amonia-calculator/>