Freshwater Ecology Issues

Waihi North Project

Dr Mike Joy

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Introduction

My full name is Michael Kevin Joy, but I am known as Mike Joy. I live in Wellington.

I am a Senior Research Fellow at the School of Geography, Environment and Earth Sciences at Victoria University of Wellington. My field of research is in freshwater ecology.

Part (A): Qualifications and experience

I have a Bachelor of Science in Ecology (1997) and Master of Science with Honours in Ecology from Massey University (1999). In 2003 I obtained my PhD in Ecology from Massey University. Both my Masters and PhD research focussed on freshwater issues in New Zealand: My Master thesis was called "Freshwater fish community structure in Taranaki: dams, diadromy or habitat quality?".

My PhD thesis was called "The development of predictive models to enhance biological assessment of riverine systems in New Zealand".

Between 2003 and 2018, I was a Lecturer, then Senior Lecturer, at Massey University in ecology and environmental science. I have been a faculty member of Victoria University of Wellington since 2018.

I have published numerous journal articles[1] on topics relating to freshwater ecology, including:

[1] A full list of my publications can be found at <orcid.org/0000-0001-9457-5013>.

MK Joy and others "The grey water footprint of milk due to nitrate leaching from dairy farms in Canterbury, New Zealand" (2022) 29(2) Australasian Journal of Environmental Management 177.

AD Canning, MK Joy, and RG Death "Nutrient criteria to achieve New Zealand's riverine macroinvertebrate targets" (2021) 9 Peer J 1.

MK Joy and AD Canning "Shifting baselines and political expediency in New Zealand" (2020) Marine and Freshwater Research.

M Joy, KJ Foote, P McNie, and M Piria "Decline in New Zealand's freshwater fish fauna: Effect of land use" (2019) 70(1) Marine and Freshwater Research 114.

MK Joy "Our deadly nitrogen addiction" in C Massey (ed) *The New Zealand Land & Food Annual Volume 2* (Massey University Press, Palmerston North, 2017) 119.

MK Joy "Freshwaters in New Zealand" in A Stow, N Maclean, and G. Holwell (eds) *Austral Ark: The State of Wildlife in Australia and New Zealand* (Cambridge University Press, Singapore, 2014) 227.

MK Joy, and RG Death "Freshwater Biodiversity" in JR Dymond (ed) *Ecosystem Services in New Zealand* (Manaaki Whenua Press, Lincoln New Zealand 2013) 448.

I have also published the following books on freshwater ecology:

Mike Joy (ed) *Mountains to Sea Solving New Zealand's Freshwater Crisis* (Bridget Williams Books, Wellington 2018).

Mike Joy *Polluted Inheritance New Zealand's Freshwater Crisis* (Bridget Williams Books, Wellington 2015).

I have been an Associate Editor of Marine and Freshwater Research Journal (CSIRO, Australia) since 2015; an associate editor for the Springer Journal — Biodiversity and Conservation since 2019; and an Editorial Panel Member for Transylvanian Review of Systematical and Ecological Research since 2010.

I have served on various technical advisory groups for government agencies. I was on the Landcorp Environmental Reference Group for four years, from 2015 to 2019. I was also on the Ministry for the Environment Science and Technical Advisory Group, or **STAG**, from 2018 to 2020.

I have developed bio-assessment tools that are used by many regional councils and consultants. I also developed the Fish Index of Biotic Integrity, which is now included in the National Policy Statement for Freshwater Management, or **NPS-FM**. I have published scientific papers in many fields from artificial intelligence and data mining to the freshwater ecology of sub-Antarctic islands.

I have received several awards for my work, including:

- an Ecology in Action award from the New Zealand Ecological Society (2009);
- an Old Blue from Forest and Bird (2011);
- a Tertiary Education Union Award of Excellence for Academic Freedom and Contribution to Public Education (2013);
- the Royal Society of New Zealand Charles Fleming Award for protection of the New Zealand environment (2013);
- the Morgan Foundation inaugural River Voice Award (2015);
- the inaugural New Zealand Universities Critic and Conscience Award (2016); and
- a semi-finalist for the 2018 and 2022 Kiwibank New Zealander of the year; and
- the Callaghan Medal, awarded annually by the Royal Society of New Zealand, in 2023 for communication efforts focussed on the decline of freshwater ecosystems and drinking water, and sustainability challenges in current food systems.

For the last two decades, I have been working at the interface of science and policy in New Zealand with a goal of strengthening connections between science, policy and real outcomes to address the multiple environmental issues facing New Zealand.

Part (B): Code of Conduct

1. I confirm I have read the code of conduct for expert witnesses as contained in the Environment Court's Practice Note 2023.

2. I have complied with the code of conduct when preparing this statement of evidence and will do so if required to give oral evidence before the Expert Panel considering the application by Oceana Gold (New Zealand) Limited (**Applicant**) under the Fast-track Approvals Act 2024 (**Act**) to expand its existing gold and silver mining operations at sites in the Waihi North area of the Coromandel Peninsula, being Fast-track Application No. FTAA-2504-1046 (the **Waihi North Project Application**).

3. I have read D.4 WRC Conditions.

4. The data, information, facts and assumptions I have considered in forming my opinions are set out in my evidence to follow. The reasons for my opinions expressed are also set out in this evidence.

5. Unless I state otherwise, this evidence is within my sphere of expertise and I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

6. My qualifications, relevant experience and basis for my expertise are as set out above.

Part (C): Comments on Boffa Miskell report for Oceana Gold

I have the following comments on the Boffa Miskell report for Oceana Gold.

My focus is to highlight my genuine concerns about the significant adverse impacts arising from the Applicant's outlined approach to stream relocation, warm spring destruction and selenium in the Ohinemuri River.

1. In the opening pages of the Boffa Miskell Report (**report**) (pages 3-6) there are statements summarising key freshwater issues. These include the intention to destroy the only warm spring in the Wharekirauponga area and sections of several waterways in the Waihi town vicinity. Justifying the “total loss” of the warm spring by offsetting with “protecting and enhancing” elsewhere, and characterising the relocation of a 1.4kn of a stream as “low Impact” and diversion of another stream as a “ low to high” impact, is unscientific. The impacts of destroying and relocating waterways are not “low to high”, they are severe for those waterways and their flora and fauna. “Offsetting” does nothing to justify this damage. In the case of the warm spring, total loss means total loss.
2. The impacts on the Warm Spring, the Mataura Stream, the Ruahorehore Stream, the Headwaters Gully stream, the TBI (tributary ?) at Northern Rock Stack are all matters of concern. The ability to restore these waterways to their optimum is nil.
3. Page 7 relates to reconsenting mine wastewater discharges into the Ohinemuri river. There is no specific information on the age of the consents being applied for “re consenting”, the breaches of those consents, or the methodology of collecting specific data for pollutants such as selenium. How many fish surveys have been carried out? What MCI data was collected related to mine pollutants.
4. Water treatment – there is no information as to how mine wastewater will be treated to remove the range of pollutants such as selenium.
5. Selenium Impacts - A Case in Point One of the many environmental impacts of hard rock gold mining is Selenium, the source of selenium is the ore (it is one of many trace elements within the ore itself). New Zealand has generally low levels of Selenium, but it is found in the same places as gold. The hard rock is crushed to the consistency of talcum powder to get the gold out and as part of the process in Waihi the wastewater from the mining area is processed and discharged to the Ohinemuri River. Selenium is a mineral which can be toxic to fish at higher levels and bioaccumulation of selenium through the food chain risks fish species and their eggs.

6. Boffa Miskell Page 116 highlights a concerning approach to selenium levels. The author of this report has actively sought to clarify why Oceana Gold, and the Waikato Regional Council are using far less robust toxicity levels for selenium in freshwater than the USEPA level is under debate by USA scientists for being too lax.
7. In the USA the union of concerned scientists https://www.ucs.org/resources/attacks-on-science/selenium-standards-misinterpret-key-research have been lobbying for a long time to change it because the author of the paper that the EPA used to come up with the limit disagrees with their conclusions and says it is too lax.
8. The effect of selenium on fish eggs, also known as the "invisible impact of selenium" *"The potential for selenium to rapidly and severely affect fish populations has been recognized for over 2 decades (e.g., Cumbie and Van Horn, 1978). However, selenium poisoning can be "invisible" because the primary point of impact is the egg, which receives selenium from the female's diet and stores it until hatching, whereupon teratogenic deformity and death may occur. Adult fish can survive and appear healthy despite the fact that massive reproductive failure is occurring (Lemly, 1985a; Coyle et al., 1993). Consequently, fish populations can decline or even disappear over the course of a few years for no apparent reason —unless one is cognizant of the subtle way in which selenium operates."* Reference: https://files.nc.gov/ncdeq/Public%20Records%202/DWR%20Records/Selenium%20on%20Fish%20Time%20Bomb%20Dennis%20Lemly%201999.pdf
9. Figure 1 below from the paper: Lemly, A. D. (1999). Selenium Impacts on Fish: An Insidious Time Bomb. Human and Ecological Risk Assessment: An International Journal, 5(6), 1139–1151. https://doi.org/10.1080/10807039.1999.10518883 shows that impacts on reproductive failure begin at 2 parts per billion and are 100% lethal to egg formation at 10 part per billion.

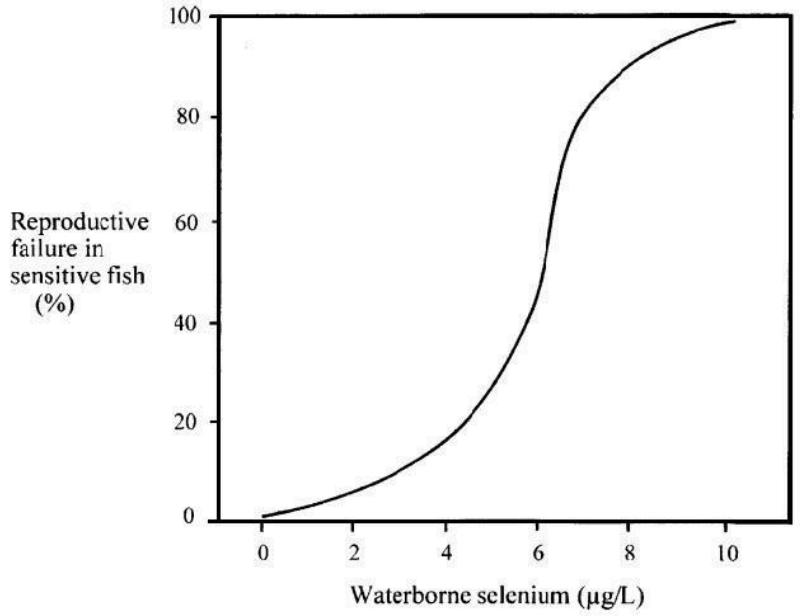

Figure 1. Relationship between the concentration of selenium in habitats favorable for bioaccumulation (*e.g.*, lakes, wetlands) and the degree of reproductive failure in sensitive fish species (*e.g.*, bluegill, *Lepomis macrochirus*). A small increase in waterborne selenium can result in catastrophic impacts on reproductive success. Recent escalation in human activities that promote the mobilization of selenium into aquatic ecosystems threatens to activate this time bomb on a widespread scale in the United States and elsewhere.

10. The current monitoring regime involves a suite of parameters being tested over a range of levels e.g. sediment, water quality, periphyton, macroinvertebrates, macrophytes and fish at a number of sites – generally six but not all of those listed are sampled at each site. For example, the annual sampling of fish is undertaken at an upstream (control) site and a downstream site within the Ohinemuri River but not at the four sites in between. Since monitoring began the data indicates that the range of selenium found in bullies is 1.8-3.5mg/kg at the control site and 4.0-8.5mg/kg at the downstream site and in eels is 2.0-3.5mg/kg at the control site and 4.8-7.7mg/kg at the downstream site.
11. Note the fish sampling consent condition is flawed: The limit suggested by Lemly is 5.85 ppm which is mg/kg so many of the fish are in the samples are around the lethal limit, therefore if the lethal limit applies to New Zealand fish and the sampling involves live fish then any fish killed by excess Selenium will not be captured (as they are dead).
12. There has been an erroneous assumption made that because selenium is found in fish at the upstream “control site” the source of the Selenium is not the mine discharge. The simple explanation is that almost all our native fish migrate upstream throughout their lives and thus they will accumulate

selenium from the discharge during their upstream migration from the sea all the way up the Ohinemuri and If they haven't received a lethal dose will eventually be found above the discharge.

13. Thus, the consent conditions are fundamentally flawed in relation to Seleium in three ways; 1. the selenium level limits are flawed because they don't include reproductive impacts, 2. the use of a 'control site' that isn't, in fact it is another impact site and 3. Because the fish sampling shows fish are already close to the lethal level of selenium it will miss fish killed by excess selenium.
14. The only real control site would be to use fish from a river on the other side of the Coromandel Peninsula as any fish migrating up from the Firth of Thames would have some Ohinemuri selenium influence. The flawed Selenium Levels used, and the lack of a true control site means that claims of 'no impact' in the past because consent conditions are met (and that claim is debatable) is in error, in fact there is ample evidence the processing plant is having significant impacts on aquatic life.
15. The company's view is that the EPA "limits" are overly conservative, has no scientific basis. Thus, claiming 'no impact' is far from proven and the next phase must be to answer that answer that question before the discharge can be assessed.

Matters to consider:

a. Is it ok to use USEPA levels? (The safe levels for NZ native fish have never been tested)
b. Why no investigation into reproductive failures, the effect of selenium of fish eggs has not been considered when levels are an order of magnitude lower than EPA limits?
c. Why do WRC take mining companies word for it whether a level is safe or not?
d. why did the reports done by Golders not look at other fish species and test safe levels in NZ fish?

e. Live fish sampling means that fish suffering sub-lethal or lethal effects of Selenium will be missed

16. I have also generally reviewed the first iteration of consent conditions. I have not reviewed, but seek an opportunity to review, the latest iteration of consent conditions, and related documents. Unfortunately these arrived too late in preparation of my evidence.