February 28, 2018

Ken Reimer
Chair, Independent Expert Advisory Committee
Happy Valley – Goose Bay, NL

Re: Comments on Azimuth February 25, 2018 memorandum titled "Evaluation of MeHg Production by Muskrat Falls Reservoir and Implications for Lake Melville – A Top-Down, Mass-Balance Approach"

Dear Ken,

Further to a request that Peter Madden forwarded to me, here are my comments on the above memorandum prepared by Randy Baker and others at Azimuth.

Overall, the Azimuth document is credible and should be strongly considered.

The Azimuth analysis uses a combination of empirical data and mass balance approaches, as does the combination of the mechanistic mass balance and regression models I applied. Both analyses predict lower increases in water column methylmercury concentrations than predicted by Calder et al. (2016). One area where there is a difference between the Azimuth approach and the RESMERC analysis we used is the estimated magnitude of methylmercury flux from the flood zone to overlying waters. The Resmerc model did not impose a limit to the fraction of inorganic Hg(II) in solids that could be converted to methylmercury and exported, while Azimuth did. The Resmerc analysis predicts a higher loss of mercury from flooded soils and a greater methylmercury load to overlying waters, relative to the Azimuth assessment.

Dr. Baker has a good point about considering the rate of decline of mercury in sediments associated with methylmercury diffusion, and cites field studies indicating that this has not been observed. I think further examination of these studies, and consideration of processes such as decomposition, which could release mercury without lowering concentrations in the remaining solids, would be useful. At this point I don't consider an upper limit to the methylmercury load to water to have sufficient certainty to require reductions to Resmerc predictions.

The difference in flood zone methylmercury loads between the Azimuth and Resmerc analyses has implications for predicted concentrations of methylmercury exported from the reservoir. However, as described below, this does not change some important downstream insights that emerge from the Azimuth analysis.

Azimuth's downstream analysis in Lake Melville provides an important comparison of the estimated methylmercury pool in biota in Lake Melville relative to the pool of methylmercury that could be loaded from the flood zone and exported downstream. Their analysis estimates the pool of methylmercury in the Lake Melville foodweb to be far greater than the flux they estimate is possible from the reservoir. I was previously aware that estuaries are productive, but did not know that the food web in Lake Melville likely has a biomass (per unit area) that is perhaps 2 orders of magnitude bigger than in the freshwater system. I can't comment further on biomass estimates, which are outside my area of expertise.

Azimuth also makes a valid point that only a portion of the methylmercury exported from the reservoir ends up in biota. Some of that load is also lost to photodegradation, settling, outflows, and a quantity is needed to increase concentrations in water and sediments. This creates a wider gap in their analysis between the amount of methylmercury needed to increase concentrations in biota, and the estimated from the reservoir.

To put the effect of the foodweb biomass in perspective, I used the Calder et al baseline concentration of 0.017 ng/L methylmercury for Lake Melville, to estimate roughly 0.5-0.6 kg of methylmercury in the top 10 m of the water column. Azimuth estimates that the food web in Lake Melville contains about 20 kg of methylmercury mercury, about 37X the mass in the 10 m surface layer. Thus, the biomass would have a strong effect on the response of the downstream system to a change in methylmercury loading. This is different than many ecosystems I have worked on where the mass of methylmercury in the food web is a secondary consideration. In lieu of having a model immediately available to account for effects of the downstream foodweb biomass (unless the Calder model does this), it may be possible in the short term (days) to roughly approximate the order of magnitude of methylmercury losses associated with settling and photodegradation, to better approximate the fraction of downstream methylmercury export from the reservoir that ends up in biota. This would provide additional context for the potential reservoir effect on downstream methylmercury concentrations.

Overall, the analysis by Azimuth identifies a key issue that should be considered when estimating the response of methylmercury in Lake Melville following reservoir creation: the large in-lake biomass and associated pool of methylmercury.

I hope this is helpful. Contact me at your convenience if you have any comments or questions.

Sincerely,

Reed Harris

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