Public comment to IJC in regards to "Proposed nutrient concentration and loading targets for the Red River at the US-Canada boundary"

Submitted on March 28, 2020 by Robert Hecky and Stephanie Guildford

Who are we?

We are retired professors from the University of Minnesota-Duluth Department of Biology and Large Lakes Observatory. Prior to our time at Duluth we were on the faculty of the Biology Department, University of Waterloo, Waterloo ON and previously were researchers with the Department of Fisheries and Oceans in Winnipeg Manitoba. We resided in Manitoba for a total of over 30 years although we now live in Waterloo. Our research careers were devoted to the study of algal ecology and trophic conditions of lakes including the North American Great Lakes and the African Great Lakes. Although Hecky serves on the Science Advisory Board of the IJC and Guildford served as a Board Member for the Lake Winnipeg Foundation, this comment is a personal one.

What is our concern?

We agree with the report of the IRRB-Water Quality Committee 2020 that setting a TP concentration objective for the Red River at Emerson below current concentrations will have a positive effect on controlling the eutrophic condition of downstream Lake Winnipeg. However, we disagree that the recommended objective for the TN concentration will have any benefit for Lake Winnipeg. To be clear, we are not opposed to the setting of an N objective for the river at Emerson; but we are opposed to identifying any benefit of the N river objective to Lake Winnipeg.

Critical facts:

The Red River supplies 68 per cent of the total TP loading (34% of TN) to Lake Winnipeg (see Fig. 1 below from Lake Winnipeg: Nutrients and Loads, Manitoba Sustainable Development, Water Science and Watershed Management Branch, 2019). Consequently, Lake Winnipeg TP concentrations are very dependent on Red River loading of TP. P loading and P concentration in Lake Winnipeg have increased over the past century (Bunting et al. 2016), especially over the past few decades (Bunting et al. 2016; McCullough et al. 2012; Schindler et al. 2012; see Figure 2 below). The USGS station on the Red River at Emerson shows increases in TP since 1980 (Figure 3 below from IRRB report) which have been contemporaneous with increases in P and algal blooms Lake Winnipeg (e.g. Schindler et al 2012). Binding et al (2018) used satellite imagery (see Figure 4 below) of Lake Winnipeg to map the extent, duration, and severity of algal blooms and found a significant increase over time (2002-20011) and a **significant correlation of these blooms with annual TP loading to the lake**.

In contrast to the chain of causation between TP in the Red River and algal blooms on Lake Winnipeg, TN concentrations and loads at Emerson have either fallen or been unchanged in the Red River at Emerson (Figure 3 below from USGS; IRRB report) during this period of increasing eutrophication, i.e. **there is no association between N at Emerson and algal blooms in Lake Winnipeg.** The Province of Manitoba has set a TP objective for Lake Winnipeg of 0.05 mg L^{-1} which is comparable to concentrations in the early

1990s. There is not a similar justification for the Province of Manitoba TN concentration objective, 0.75 mg L^{-1}, provided in the IRRB report although the stated objective would be close to TN concentrations of the early 1990s (Lake Winnipeg: Nutrients and Loads, Manitoba Sustainable Development, Water Science and Watershed Management Branch, 2019). Bunting et al. (2016), based on fossil pigments and the nutrient preferences of diatoms and the fossil assemblages they found in sediment cores from Lake Winnipeg, concluded that, prior to the 20th century, TP concentrations were likely in the range of 0.015 to 0.020 mg L^{-1}, notably below the present lake concentration objective of 0.05 mg L^{-1}. The IRRB report does not discuss why this lower concentration or some other intermediate concentration might not be adopted as an objective instead of 0.05 mg L^{-1} for Lake Winnipeg. Bunting et al (2016) did not address historic TN concentrations prior to the last century as no appropriate datasets are available for TN preferences of diatoms and N was not limiting algal abundance. It is difficult to set TN objectives in lakes because of internal processes such as nitrogen fixation and denitrification can influence TN concentrations independent of N catchment loading.

IJC nutrient objectives and targets for the Great Lakes

There is no N objective for the boundary waters of the Laurentian Great Lakes where recovery from eutrophication after GLWQA has been achieved by reducing **P loading only** (Dove and Chapra, 2018). Furthermore, the efficacy of P management to reduce eutrophication is supported by data from lakes around the world (Schindler et al 2016). The IJC has been a leader in developing and applying the P only strategy for lakes.

In 1969 a joint report of the Water Pollution Control Boards of Lake Ontario and Lake Erie recommended to the IJC that phosphorus loading reductions alone would lead to recovery of the lakes and that it was technically feasible and cost effective. The IJC accepted this recommendation and then eventually recommended to the governments the P only strategy with targets for loading and concentration objectives for all the lakes which were enshrined in the Great Lakes Water Quality Agreement of 1972. In the 2012 amendment of the GLWQA, the success of the P only strategy was again endorsed as the foundational bi-national policy for protecting the health of the Great Lakes. In 2015 the governments of Michigan, Ohio and Ontario agreed to work together toward a 40% reduction by 2025 in the amount of total and dissolved reactive P entering Lake Erie's Western Basin which had been suffering a re-emergence of algal blooms due increasing inputs of P from agricultural lands particularly in the Maumee River (Ohio), remarkably similar to the issues confronting Lake Winnipeg and the Red River. This agreement informed the **Lake Erie Binational Phosphorus Reduction Strategy**, a 2019 report of the GLWQA Nutrients Annex Subcommittee. We strongly urge the IJC apply a P focused strategy in considering the implications for Lake Winnipeg of setting nutrients objectives for the Red River at Emerson. Reduction in P alone will be effective in reducing the eutrophication of Lake Winnipeg, and it will be consistent with the Binational Strategy developed and endorsed by the IJC for Lake Erie and other Great Lakes.

Figure 1 (from cited Manitoba government report). Proportion of total P and N loading to Lake Winnipeg. The Red River is the overwhelming source of total P.

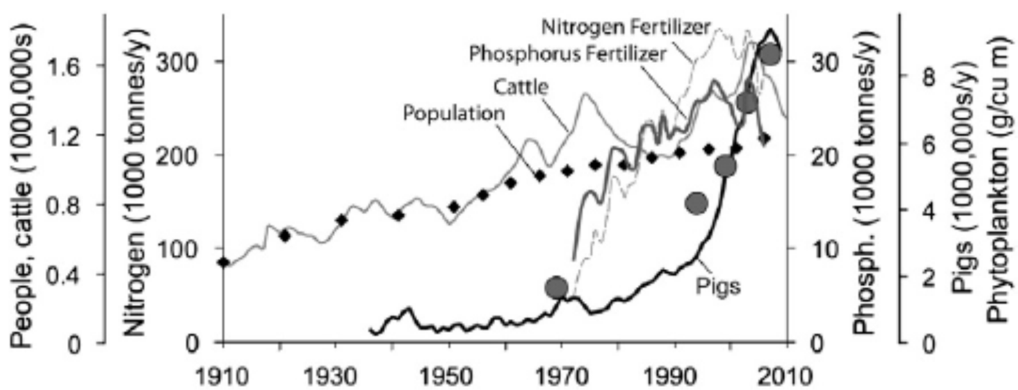

Figure 2 (from Schindler et al, 2013). Increasing human and livestock populations and fertilizer utilization in the Lake Winnipeg basin. Response of lake phytoplankton biomass is shown with filled circles

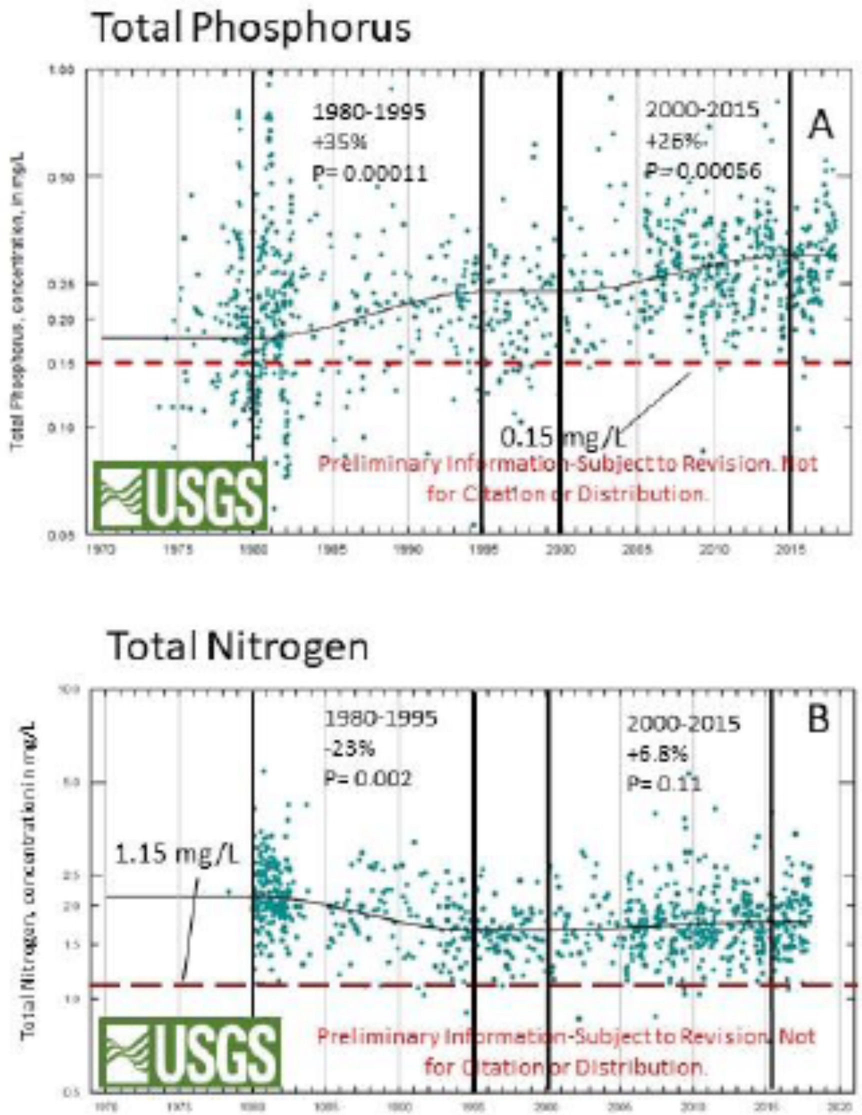

Figure 3 (Figure 6 of IRRB –Water Quality Committee Report). TP concentrations at Emerson have been increasing since 1970 with two periods of more rapid increase continuing up to the present. In contrast TN has declined since 1980 although little change since 2000.

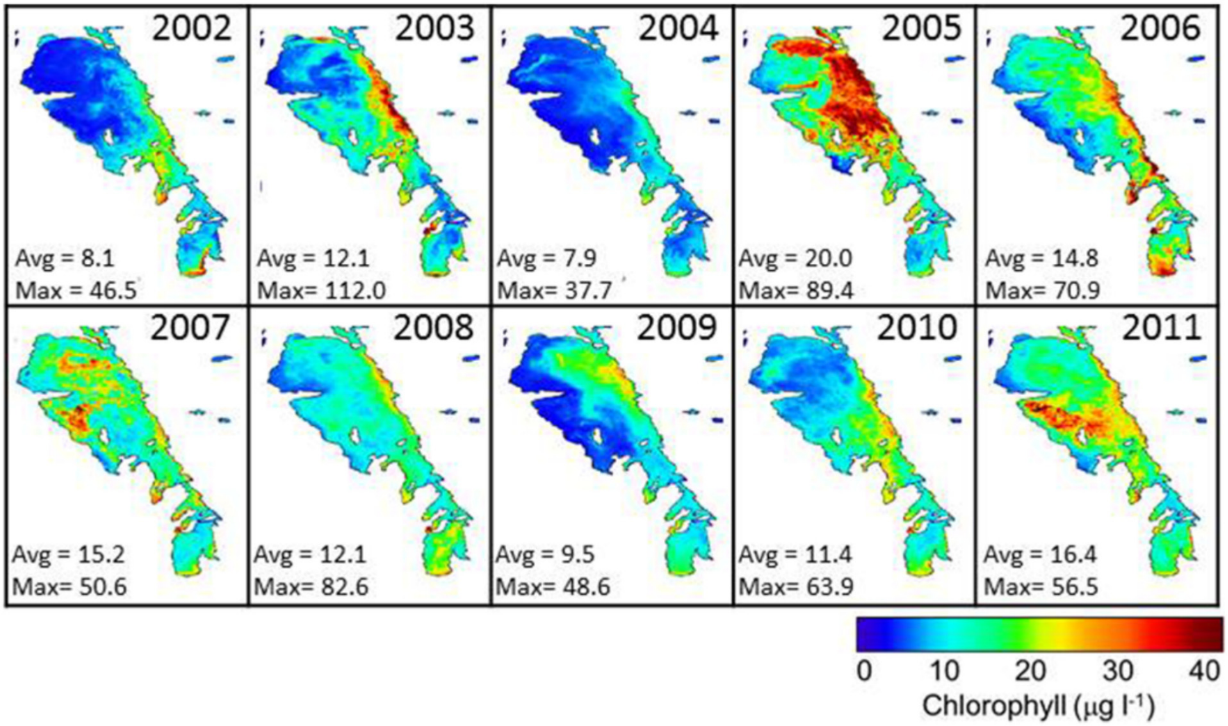

Figure 4 (from Binding et al. 2018) Satellite derived maps of algal blooms on Lake Winnipeg showing increasing trend from 2002 to 2011 contemporaneous with increasing P loading at Emerson.

References cited:

Binding, C.E., T.A. Greenberg, G. McCullough, S.B. Watson, E. Page. 2018. An analysis of satellite-derived chlorophyll and algal bloom indices on Lake Winnipeg. J. Great Lakes Res. 44, 436-446.

Bunting, L., P. Leavitt et al. 2016. Increased variability and sudden ecosystem state change in Lake Winnipeg, Canada, caused by 20th century agriculture. Limnol. Oceanogr. 61, 2090-2107.

Dove, A. and S.C. Chapra. 2015. Long term trends of nutrients and trophic response variables for the Great Lakes. Limnol. Oceanogr. 60, 696-7221

McCullough, G. K., Page S. et al. 2012. Hydrologic forcing of a recent trophic surge in Lake Winnipeg. J. Great Lakes Res. 38 (Suppl. 3), 95-105

Schindler, D.W., R.E. Hecky, G.K. McCullough. 2012. The rapid eutrophication of Lake Winnipeg: Greening under global change. J. Great Lakes Res. 38 (Suppl. 3), 6-13.

Schindler, D.W., S.R. Carpenter et al. 2016. Reducing phosphorus to curb lake eutrophication is a success. Environ. Sci. Technol. 50(27),8923-8929.

Water Pollution Control Boards of Lake Ontario and Lake Erie. 1969. Report to the International Joint Commission on the pollution of Lake Erie, Lake Ontario and the international section of the St. Lawrence River. Volume 1-Summary. 103 p. plus appendices.