Global Water Futures 2021 Operations Team Meeting – Project Reporting Template

Instructions: All GWF projects are asked to provide a summary update on their activities and accomplishments in preparation for the upcoming Operations Team meeting. **Please submit these by email to chris.debeer@usask.ca by no later than December 2.** These will be used to help guide discussions and breakout synthesis activities and will be made generally accessible on our website in advance of the meeting.

Project Name:	FORMBLOOM (FORecasting tools and Mitigation options for diverse BLOOM-affected lakes)

Our major accomplishments to date are: (here we note the narrative of major areas of work, with key contributions in those areas).

Biophysical work to understand factors influencing bloom severity, factors influencing bloom duration, and key interventions. This includes setting the stage for a whole ecosystem experiment, now in progress.

- Molot LA, Higgins SN, Schiff SL, Venkiteswaran JJ, Paterson MJ, Baulch HM. 2021. Phosphorus-only fertilization rapidly initiates large nitrogen-fixing cyanobacteria blooms in two oligotrophic lakes. Environmental Research Letters 16: 6, doi: 1748-9326/ac0564.
- Molot LA, Higgins SN, Schiff SL, Venkiteswaran JJ, Paterson MJ, Baulch HM. 2021. Phosphorus-only fertilization rapidly initiates large nitrogen-fixing cyanobacteria blooms in two oligotrophic lakes. Scholars Portal Dataverse, doi: 10.5683/SP2/Q7FYSI.
- Larsen ML, Baulch HM, Schiff SL, Simon D, Sauvé S, Venkiteswaran JJ. 2020. Extreme rainfall drives early onset cyanobacterial bloom. FACETS, 5(1): 899-920, doi: 10.1139/facets-2020-0022.
- Larsen ML, Venkiteswaran JJ. 2019. Data for "Extreme midsummer rainfall event drives early onset cyanobacterial bloom". figshare. Dataset. https://doi.org/10.6084/m9.figshare.7811963.v1
- Boyer L. 2021. The dynamics of biological nitrogen fixation in prairie lakes. MES thesis. University of Saskatchewan. https://hdl.handle.net/10388/13318

Work to support adaptation to current bloom conditions. This includes research assessing the status of bloom communications work, including work in collaboration with Indigenous communities, work to advance forecasting, remote sensing, communications efforts, and partnered work helping adapt water treatment processes and avoid the repeat of major incidents affecting water supply.

- Rashidi H, Baulch H, Gill A, Bharadwaj L, Bradford L. 2021. Monitoring, Managing, and Communicating Risk of Harmful Algal Blooms (HABs) in Recreational Resources across Canada. Environmental Health Insights 15: 1-14, doi: 10.1177/11786302211014401.
- Kehoe MJ, Ingalls BP, Venkiteswaran JJ, Baulch HM. Successful forecasting of harmful cyanobacteria blooms with high frequency lake data. bioRxiv 674325 doi: 10.1101/674325.
- Baulch HM, Venkiteswaran JJ, Davies J-M. 2018. The Water Quality Toolbox. Lakeline. 38(3): 16-19
- Chegoonian, A. M., Leavitt, P., R., Zolfaghari, K., Davies, J-M., Baulch, H., M., and Duguay, C., R. Regional upscaling of chlorophyll-a retrieval from small eutrophic lakes via Sentinel-2: A case study of the Qu'Appelle River drainage basin, Canada. (*near submission)*
- Chegoonian, A. M., Pahlevan, N., Zolfaghari, K., Leavitt, P., R., Davies, J-M., Baulch, H., M., and Duguay, C., R. Quantification of chlorophyll-a in small eutrophic lakes using Sentinel-2 and Landsat-8 imagery and locally tuned machine learning models. *ISPRS Journal of Photogrammetry and Remote Sensing*. (Submitted, under review)

- Chegoonian, A. M., Zolfaghari, K., Leavitt, P., R., Baulch, H., M., and Duguay, C., R. Improvement of field fluorometry estimates of chlorophyll-a concentration in a cyanobacteria-rich eutrophic lake. *Limnology and Oceanography: Methods*. (Revision submitted)
- Chegoonian, A. M., Zolfaghari, K., Baulch, H. M., Duguay, C. R., (2021). Support vector regression for chlorophyll-a estimation using sentinel-2 images in small waterbodies. *In 2021 IEEE International Geoscience and Remote Sensing Symposium IGARSS (pp. 7449-7452). IEEE.*

Our current activities are:

- Identify the seasonal evolution of harmful cyanobacteria and their toxins in a crucial drinking water supply, Buffalo Pound Lake SK, including identifying risk-indicator species. This will become a journal article (early 2022 submission).
- Identify the necessary preconditions for cyanobacteria bloom formation across multiple lake types in Canada. This will become a journal article (mid 2022).
- Whole-lake fertilization and redox treatment in Lakes 303 and 304 at IISD – Experimental Lakes Area (re-initiating experiment in 2022).
- Work to assess public preferences, and willingness to pay to support water quality improvement. (current survey on Elk/Beaver Lake).
- Experimental assessment of toxicity risk associated with nitrogen loading.
- Leverage FORMBLOOM into a new NSERC Alliance grant to support a 5-year whole-lake experiment at IISD – Experimental Lakes Area (2022 submission).
- Launching new northern collaborations on Jackfish Lake.
- Recruitment. (Microbiologists have been in high demand. Need to recruit and push towards final stages of project).

The main accomplishments expected by the end of the project are:

- Understanding current management and communication on risks in Canada and forging partnerships to enhance management and communications in areas of high risk including working with Indigenous communities.
- Enhanced understanding of adaptation needs, with case study of partnership with Buffalo Pound Water Treatment Plant to help foster municipal water treatment adaptation. This has already led to adapted water treatment processes to account for cyanobacterial ecology and risk.
- Continue to work with partners such as the IISD – Experimental Lakes Area to understand the potential using controls on sediment redox to limit cyanobacteria blooms
- Prototype forecasting system (proof of concept).
- Detailed work across small number of highly diverse lakes to understand drivers of blooms, and potential interventions
- Case study analysis of willingness to pay for interventions, and priorities for change resulting from management interventions (preferred ecosystem service changes).

Here is a key visual from the project (figure, photo, table, graph, etc.)

Rather than a key photo, we note key synthesis goals that could touch across projects:
We see the need to coordinate of key insights and communications efforts related to work to understand and manage water quality.

- Coordinated messaging in particular on:
    - Critical decline in water quality in many regions of the nation. (emphasis to coordinate is need for agricultural interventions, and importance of managing nutrients very carefully with blooms as an exemplar of risk)

• Importance of bloom risk, risk perception, bloom management, and willingness to pay to improve water quality. • Place-based nature of problems, place-based nature of solutions means we need for increased capacity and coordination to help address water quality issues. Current disjointed management, and limited capacity in many regions is a barrier to progress. Coordination and co-learning is required.