Kahshe Lake Near-Shore Water Sampling Project – 2021

Executive Summary of Updated Final

Kahshe Lake Ratepayers' Association
Conservation Committee

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November 1, 2022

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EXECUTIVE SUMMARY – KAHSHE LAKE NEAR-SHORE WATER SAMPLING PROJECT- 2021

CONSERVATION COMMITTEE – KAHSHE LAKE RATEPAYERS' ASSOCIATION

NOVEMBER 2022

Both Kahshe and Bass Lakes have been classed as 'Vulnerable' by the District Municipality of Muskoka (DMM) under the Muskoka Official Plan and this will be considered in the review of development proposals starting in 2021. Bass Lake is considered vulnerable because of a total phosphorus level greater than 20 parts per billion (ppb) and Kahshe Lake because of the confirmed harmful algal bloom (HAB) in November 2020.

The DMM initiated 'Causation Studies' on 10 lakes with confirmed blooms in 2020 and the two lakes with total phosphorus (TP) levels exceeding 20 µg/L (parts per billion). However, because of budget limitations, only five of these Causation Studies were undertaken in 2021, with the others being delayed until the completion of the first five.

As all water quality monitoring on Kahshe Lake is conducted in deep, mid-lake locations, these historical data provide an excellent base upon which to evaluate long term trends in lake water chemistry; however, they may not be providing a representative measure of water chemistry and nutrient loading in the shoreline areas, particularly in the most heavily developed areas of Kahshe where shorelines have been disturbed/managed for recreational use. Concern regarding shoreline contributions is exacerbated by the fact that the Town of Gravenhurst's Septic Re-Inspection Program has not taken place since 2009 for water access properties and since 2013 for road access properties.

Based on the foregoing concern, the Kahshe Lake Ratepayers' Association's (KLRA) Conservation Committee developed a pilot Near-Shore Water Sampling Program to explore and characterize water chemistry and to examine how water chemistry close to the shore changes as the season progresses. The temporal aspect to the study was considered important, as the mid-lake sampling and analysis for algal friendly nutrients by the DMM and the Ontario Ministry of Environment, Conservation and Parks (MECP) is conducted only in May. The Near-Shore project commenced in May 2021 and included additional sampling in late-July and late-September. To keep costs as low as possible, it was focussed on the most heavily developed areas of the lake along Oak Road and the north shore and was carried out by Conservation Committee volunteers. However, because of the known input from Bass Lake, additional sampling was included in the east end of the lake.

After a review of the relevant literature and discussion with the KLRA, six goals were developed as shown below:

1. Are algal friendly nutrient levels from traditional spring sampling of mid-lake sites which have remained fairly low and stable over the past 35-40 years representative of water quality in the near-shore environment where algal blooms typically appear?
2. Are algal friendly nutrients in the near-shore environment where blue-green algal blooms have been confirmed in 2020 and 2021, increasing as the season progresses, resulting in a further disconnect with the historical data which are based on spring sampling of mid-lake sites?
3. Are near-shore waters being impacted by fecal contamination at levels of concern for recreational use and as a source of drinking water?
4. Do these findings shed any light on why Kahshe Lake is now vulnerable to late season blue-green algal blooms?
5. Do these findings provide any insight into a possible causal role or association with any of the typical shoreline sources of algal friendly nutrients that could be further investigated in the DMM-funded Causation Study? Typical shoreline sources include:
    A. Migration of septic system effluents.
    B. Contamination from waterfowl and other types of animals.
    C. Nutrient leaching/runoff from lawns and beaches.
    D. Soil erosion/runoff from disturbed shorelines.
6. Based on the findings of this program, is there anything the KLRA can do to educate and/or inform stakeholders on actions that could improve water quality and reduce the likelihood of continued late season algal blooms?

Summary of Findings from the Six Goals

- The near-shore analysis results for total phosphorus (TP) in the heavily developed Oak Road and North shore areas in mid-May were in line with the mid-lake TP levels. However, this was not the case In the East end of the lake, where TP levels were well above those from existing DMM and MECP mid-lake locations.
- Based on the near-shore water quality data, there is compelling evidence that the historical sampling by the DMM and MECP of mid-lake locations in the spring of the year is not providing a fully representative assessment of water quality in the near-shore environment as the season progresses. As such, the sensitivity of Kahshe Lake to late-season HABs cannot be reliably determined via mid-lake nutrient concentrations that comprise the historical database.
- Another important finding of this project is that the water quality data generated by the mid-lake sampling sites of the DMM and MECP programs likely under-report nutrient levels in the East end of the lake where elevated nutrient loads enter Kahshe Lake from Bass Lake via the Kahshe River. This is due to the absence of any DMM or MECP mid-lake sampling sites in the East end of the lake.
- As none of the fecal coliform levels exceeded the Canadian Recreational Water Quality Guideline for a single sample of 400 CFU/100mL, there should not be any concern regarding the use of shoreline waters for swimming and other recreational activities.
- However, as the Ontario Drinking Water Standard for fecal coliforms is 'Not Detected', all reported levels from mid-May through late-September do exceed the safe drinking water standard and as such, property owners using surface water from Kahshe Lake as a potable supply need to ensure that their treatment system is effectively removing this contamination prior to its use as drinking water.

The evaluation of near-shore water chemistry in relation to HAB development was rendered even more realistic in 2021 as HABs were observed in the immediate vicinity of several near-shore sampling sites the day following the last, September 30 sampling. Based on this, the investigation revealed that:

- The HABs in the west end of the lake along the Oak Road shoreline developed in the presence of typical TP concentrations of around 10 parts per billion (ppb), while the HABs at near-shore sites in the East end of the lake developed in waters that had more than twice the levels of TP (23-26 ppb).
- However, the near-shore sites in both the West and East areas of the lake that developed HABs immediately following our September 30th sampling all had elevated ammonium-N levels, suggesting a causal role for this form of nitrogen.

As phosphorus is recognized as the principal nutrient driver of algal bloom development, there are a number of possible reasons for the appearance of the bloom in the Oak Road area where TP levels immediately prior to bloom development were in a normal range, and these are discussed in the report.

The near-shore sampling program was not designed to identify a property-specific source of algal friendly nutrients. However, by selecting a number of different shoreline types and including sites with no development, the investigation findings were evaluated to explore possible/plausible linkage with known sources of algal friendly nutrients. This was undertaken by:

- Examining the environmental mobility and biological availability of phosphorus and nitrogen,
- Assessing the chemical composition of septic effluents, waterfowl feces and leaching/runoff from managed lawns,
- Determining if any of the over 35 different chemicals that were analyzed could be used as tracers of the above sources based on published studies where these types of relationships have been explored, and,
- Evaluating the role of climatic variables that have been identified as outcomes of climate change to see if there were any plausible reasons to explain why Kahshe Lake is now vulnerable to late-season HABs.

Based on the characteristics of the above four potential shoreline sources, the most likely origin of the nutrients found in the near-shore water was a combination of septic system effluents and waterfowl feces, as both

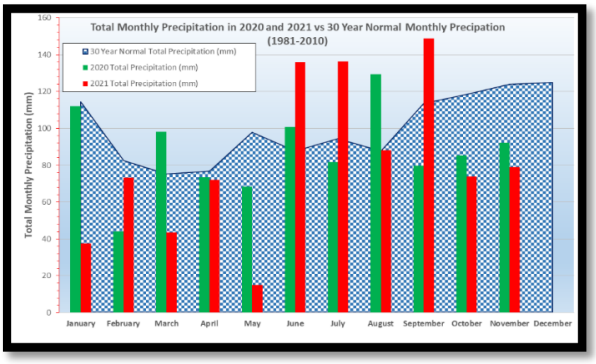
phosphorus and the ammonium form of nitrogen are characteristic of these sources. The fact that ammonium-N levels were not detected in May, prior to occupation by most property owners and before Canada geese become heavy grazers of lush lawn areas adds further support to these sources being involved in the late-season HABs.

The leaching and/or runoff of from lawns and beaches typically involves the more water soluble nitrate-N which was elevated in the mid-May sampling but decreased as the season progressed. However, as managed lawn areas located in close proximity to the shoreline attract Canada geese and other waterfowl, they cannot be ruled out as contributing sources of algal friendly nutrients. And finally, the contribution from soil erosion/runoff from disturbed shorelines was considered a minor contributor.

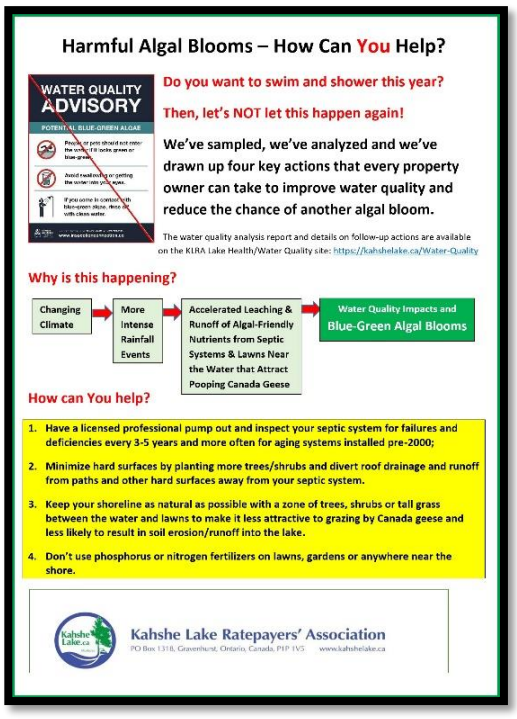
So, why has Kahshe Lake suddenly become susceptible to late season HABs - i.e. what has changed?

Some of the published studies in recent years attribute the trend toward increasing numbers of late season HABs to one or more components of a changing climate. While the Near-Shore program was not designed to comprehensively evaluate the impact of climatic variables, the one climatic factor that does appear to be changing is the severity/intensity of rainfall events.

As shown in the chart aside, monthly rainfall in both 2020 and 2021 significantly exceeded the 30 year normal and in 2021 resulted in an elevation of the lake by over 30 cm in July, resulting in many shallow shorelines and beach areas being submerged for several days. In addition to the release of algal friendly nutrients sourced from coarse-textured sands with low nutrient adsorption capacities and waterfowl feces being submerged during these high water periods, the atypical rainfall received also is likely to have accelerated the leaching of 'legacy' phosphorus and nitrogen nutrients sourced from septic effluents and from near-shore lawns and manicured/disturbed waterfronts.



Based on the findings of this sampling and analysis project, the Conservation Committee developed a science-based action plan that can be deployed by shoreline property owners and the Municipal agencies with responsibility for ensuring that future development proceeds with appropriate regard for shoreline protection and the installation of new and inspection of existing septic systems on waterfront properties. Based on the findings from this investigation, the actions required to minimize the potential for future HABs have been briefly summarized in this report and published in full on the KLRA's Lake Health web portal. The graphic below summarizes the actions that all shoreline property owners can take to minimize the potential of another HAB.



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