

September 11, 2021

Jeff Van Belle
Indian Lake Governmental Lake Board
120 N Broadway
Suite 215
Cassopolis, MI 49031

Re: Response to Tim Hull's Letter dated September 10, 2021

Dear Mr. Van Belle:

I am writing this letter in response to Tim Hull's September 10, 2021 letter to the Indian Lake Governmental Board regarding the Indian Lake weed control five-year plan (for clarity the appropriate title is Five Year Plan for Indian Lake, Cass County MI).

It's clear from Mr. Hull's letter that he has great passion for and a vested interest in the quality of Indian Lake. It's also clear that Mr. Hull desires a science-based approach for the management of Indian Lake. These are qualities I enjoy seeing from our clients and the communities they serve. However, much of the information presented in Mr. Hull's letter includes misinterpretation of the results provided in the Indian Lake five-year plan, comments that are not supported by data, and misunderstandings of limnology and lake management. As a result, I'd like to offer you (and Mr. Hull) the following responses, which I hope clear up the misunderstandings.

Before providing responses, I would first like to highlight my credentials in lake management as I believe it's important for you to know my experience and qualifications in this type of work. I am Certified Lake Manager with the North American Lake Management Society, a professional certification that requires rigorous experience and education in lake management. I have been practicing for 25 years and have published in peer reviewed scientific journals on lake management topics. I routinely develop lake management plans for hundreds of lakes in the upper Midwest. In doing so, I have helped many lakes meet their water quality objectives, recreation objectives, and improve overall lake health. These efforts have resulted in lakes being removed from the EPA's federally impaired waters list, control of invasive plants with reductions to minimal levels, and recreation restored to many water bodies. I also feel compelled to note that neither I, nor Barr Engineering Co. (Barr) who employs me, is selling products to the ILIA and we have no financial incentives in our recommendations beyond being retained to provide professional consulting and monitoring services in the future. Further, I understand that the ILIA conducted a rigorous proposal and credential review to select Barr to develop the five-year plan for Indian Lake.

The remainder of this letter provides responses to information in Mr. Hull's letter as it pertains to misrepresentation of my comments and inaccurate interpretation of results. Again, I hope this provides clarity to address misunderstandings.

In the letter Mr. Hull quoted me as saying at the August 28, 2021 ILIA annual meeting:

1. "I'm not sure why TP lowered after aeration was begun."

2. "I'm not really sure why water clarity degraded after 2016."
3. Paraphrased: Aeration doesn't eliminate muck. And the aerators probably contributed to disruption and relocation of siltation at the lake bottom.

As it pertains to these items, it's important to note that thorough discussion was provided regarding both the quality of past data collected on the lake and the fact that the data were not collected for year over year comparisons. Data prior to aeration were collected in only June and October of 2010 and 2011, which is not a statistical representation of seasonal water quality. Further, these data were only collected in one area of the lake. Data after the implementation of aeration were only collected three times per season with two of the data points on the fringe of the growing season. While these data represent the best available data for the lake, year over year comparisons must be interpreted with extreme caution, which I stated during my presentation.

Moreover, total phosphorus was not lower in the southern portion of the lake where aeration occurred when compared to the unaerated control site. This demonstrates that aeration was not affecting total phosphorus in the lake. Further, the experimental design in the 2012 Lakeshore Environmental Report (2012) report was flawed as it violated many basic statistics rules such as independent samples and autocorrelation. Even with the flawed approach, the 2012 Lakeshore Environmental report clearly states that there was no significant difference in total phosphorus in the unaerated and aerated sites. So, it is likely that flawed experimental design in the monitoring program skewed the results and it would be inappropriate to interpret the results as improved water quality following aeration. So, the quote of "I'm not sure why" was out of context of my overall interpretation. My point was simply that the experimental design and data collection does allow for clear identification of the impacts from aeration on Indian Lake and that changes in total phosphorus over time cannot be evaluated with the current data collection approach because it does not statistically account for annual and seasonal variation.

It also needs to be emphasized that there are flaws in the monitoring conducted in the Mann Drain data collected by the ILIA's previous contractor including inappropriate method detection and reporting limits, no paired flow data, and only three data points per year which does not accurately reflect seasonal variation. Following the presentation, I was provided a copy of the EGLE Mann Drain study which solidified the conclusions presented to the ILIA and this information was referenced in the draft five-year plan. Further, our interpretation of the data was consistent with the EGLE results that the Mann Drain does not appear to be a source of nutrients to Indian Lake beyond background loading. Mr. Hull's statement that "The data collected by Mr. Matousek clearly indicates water entering the lake from the Mann Drain holds a much higher nutrient load than the water in the lake" does not reflect a proper understanding of limnology. Limnological principals establish that lakes respond to loading (mass/time) and not concentration (mg/L) of watershed runoff. However, flow was never collected, and load could not be calculated. Violating this basic understanding of lake response to nutrients likely led previous lake managers to recommend installation of the Mann Drain filters. The data collected by the previous contractor and presented in our report demonstrate no significant change in water quality in the Mann Drain following the installation of the filters.

Mr. Hull states in his letter, "During the years in which the nutrient filters were installed in the drain (with permits provided by then Drain Commissioner Bruce Campbell), water quality measures of the lake were in a continuous state of improvement, suggesting that if given relief from nutrient sources pouring into the lake from upstream and with oxygen added to the lake bottom, the lake can virtually begin healing

itself. During this period, the lake was reclassified from being eutrophic to mesotrophic. Yet, as mentioned above, those quality measures are showing negative changes since the filters were removed." These conclusions are unsupported by data collected by previous contractors and in my professional opinion, it represents a misleading view of the role of aeration in lake management. Water clarity in the lake decreased by almost one half from 2016 to 2020 while chlorophyll-a concentrations remained very low. Therefore, the reduction in water clarity was unrelated to nutrient fueled algal growth after the filters were "saturated" and then removed. It should also be noted that little information was provided on the filters, how they were determined to be "saturated", and the amount of phosphorus removed. The change in water clarity is much more likely to be a result of the ever increasing Curly-leaf pondweed infestation that senesces (starts to die off) mid-summer exposing sediments for resuspension.

During the period of aeration, Eurasian watermilfoil and Curly-leaf pondweed expanded throughout the lake and now appear to dominate more than a third of the littoral area in the lake. The expectation that whole lake aeration would control invasive species was flawed and Indian Lake is paying the price. Further, the notion that whole lake aeration would control invasive species is unsupported in the scientific literature and the lake management community and is based on highly a flawed scientific study that was never published in peer reviewed scientific literature or even reviewed by professionals in the field of lake management.

One of the primary issues with the current understanding and tracking of lake changes in Indian Lake is the lack of quantifiable data that allows for objective interpretation of the results. For example, previous contractors used remote sensing techniques that are relatively new and require extreme caution in interpretation of the results. Further, the data do not include any information about the species, a critical data point in understanding lake communities. The previous contractor was unwilling to provide these data to Barr for our review. While we believe the use of echo-sounding is a useful tool in tracking aquatic plants, the surveys provided in the lake 2019 Restorative Lake Sciences report do not control for seasonal or annual variability of aquatic plant communities. Surveys conducted from 2014 through 2017 were collected in May through August while 2018 and 2019 surveys were collected in September and October when the plant community is actively senescing (dying off). Suggestions that biovolume is reducing because of whole lake aeration is skewed by the inconsistent date of collection of the plant community. Further, without species information, any changes in biovolume may be a result of species changes in the plant community. For example, Curly-leaf pondweed has expanded through the lake in the past 10 years when these surveys were occurring. Curly-leaf pondweed senesces mid-summer, leaving large gaps in the aquatic plant community and reducing the biovolume of plants in the lake. Using the echosounding data without species information could lead to an erroneous conclusion that overall biovolume is decreasing because of whole lake aeration when in reality it is just measuring the expansion of the Curly-leaf pondweed infestation.

The same problems exist with evaluating bottom hardness changes with the echosounder. Mr. Hull provided the following comment, "Additionally (and not mentioned in the Bischoff report), lake bottom hardness continued to show progressively positive measures, indicating reduction of the muck mass on the lake bottom, and aquatic vegetation lake bottom coverage improved, approaching the suggested aquatic vegetation coverage for a full recreation lake of about 35% as found in lake management literature."

Bottom hardness measurements using the BioBase echosounder has the same issues as the aquatic plant biovolume data in that early data was collected when plants biovolume was high, which will result in reading softer sediments simply because of the interference with aquatic plants. Because later surveys

were collected during plant senescence (die-off), measured changes in bottom hardness are likely a result of inconsistent data collection and the fact that bottom hardness measurements are impacted by the current biovolume of the aquatic plant community. The lake management community has long recognized that there is no evidence that whole lake aeration leads to organic material reduction in lakes. While there are no studies published in peer reviewed journals that confirm aeration can lead to reductions in sediment organic material, Engstrom and Wright (2002) definitively demonstrated that whole lake aeration does not enhance the removal of organic sediments from lake basins.

Regarding Mr. Hull's concerns with the recommended fluoridone treatment including the statement, "There is considerable evidence that Fluoridone (sic) is not an effective controller of hybrid Eurasian water milfoil (sic) such as is present in Indian Lake. Further, as has been evidenced on Indian Lake and on many Michigan lakes, this chemical treatment application tends to result in harsh outbreaks of blue green algae growth in years subsequent to application." I would certainly invite Mr. Hull to provide the data or studies that show increased blue green algae growth in years subsequent to application as it's information I am not aware of and would be interested in reviewing. While it is true that some genotypes of Eurasian watermilfoil can be resistant to fluoridone, it was demonstrated to be effective in Indian Lake in the past as summarized in our report. Identifying the right chemical will require an adaptive approach, but we have the tools to be effective in the long term. What is clear is that whole lake aeration has provided no control of the invasive Eurasian watermilfoil or Curly-leaf pondweed infestation in Indian Lake.

The recommendations provided in Barr's five-year plan for Indian Lake are based on decades of experience, approaches that have been vetted in the scientific literature, and the input of professionals in the field of limnology and lake management. Lake management is a difficult endeavor and there are no quick fixes especially when it comes to managing invasive species. We believe the ILIA would be well served to follow the recommendations of the five-year plan with adaptive management based on data and demonstrated technologies in the field of lake management.

I can appreciate that previous bad advice and poor experimental design in data collection and experiments can lead to misunderstanding especially when the approaches we are recommending are a departure from previous experiences. It is our hope that this letter and the five-year plan provides the information necessary to help you and Mr. Hull understand the basis for our recommendations and approach. We welcome independent, unbiased review of our recommended approach and suggest you contact EGLE, the Michigan DNR, or local Universities for their review and input on the management of Indian Lake.

In closing, I'd like to express my concern for Indian Lake if the current approach of implementing aeration and ignoring the ever-growing invasive species problem is continued. If Eurasian watermilfoil and Curly-leaf pondweed are allowed to expand unfettered while the ILIA focuses on lake issues other than the most pressing issues, there is a reasonable probability that the lake could collapse into a turbid water state dominated by potentially toxic blue-green algae, all but eliminating the recreational uses of the lake. My hope is that the ILIA will use a science-based approach supported by statistically relevant data as is presented in our Five-Year Plan for Indian Lake, Cass County, MI to improve and protect Indian Lake for residents now and for future generations.

Thank you for the opportunity to provide this response and we welcome further discussion regarding Indian Lake. Please feel free to contact me at jbischoff@barr.com or 612-616-9909.

Sincerely,



Joe Bischoff

Certified Lake Manager, 16-06M

REFERENCES

Daniel R. Engstrom & David I. Wright (2002) Sedimentological Effects of Aeration-Induced Lake Circulation, *Lake and Reservoir Management*, 18:3, 201-214.