

Lake Aeration – David Emmons

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President, Lake St. Catherine Conservation Fund, Inc.

501 c3 Nonprofit

I'm here today because we need your help. My name is David Emmons and I am the President of the LSCCF: 501 c3 nonprofit, 100% grassroots, volunteer organization. For the past 10 years, our organization has been devoted to researching and implementing holistic, sustainable, environmentally-friendly technologies for lake restoration in an effort to not only reverse the effects of eutrophication in Little Lake Saint Catherine in Wells VT, but also to find alternatives to risky, toxic, unsustainable chemical treatments – and we have had a successful, albeit limited, system running in the lake for the past six years and the reason I'm here today is because the Department of Environmental Conservation has given us *strong* indications that they will not be renewing our permit and intend to shut our whole project down.

Let me share a quick history with you. For 10 years, the LSCCF has been doing a lot of research and testing to better understand our changing Lake ecology.

- core sampling and analyzing
- water quality monitoring
- dissolved oxygen monitoring
- and extensive depth measuring to the hard bottom of the lake and top of sediment – which in much of the lake is 30 to 40 feet thick.

We have also been working with leading scientists like Professor Wayne Carmichael, Dr. Jennifer Jones, Larry Eichler, Dr. Alex Horne, Dr. Ken Wagner, and many others to better understand what our data collection was telling us.

It was obvious to those of us who have lived on the lake for decades that as early as 2004 the lake was suffering, filling in, and indeed feeling the stresses of eutrophication and our data now showed that our concerns were correct and that Little Lake would greatly benefit from new advances in lake bioaugmentation – a multi-pronged lake restoration technology of laminar flow oxygenation combined with microbes and enzymes to increase the rate of decomposition and

deepen the lake – alleviating a multitude of problems caused by the shallowing and excessive and invasive vegetation filling in the lake.

- loss of navigation
- loss of swimming
- loss of spawning areas for fish
- reduction of fish variety, health, and size due primarily to low D.O. (Dissolved Oxygen)
- foul-smelling water
- fish-kills
- epidemic level of submerged vegetation, largely the vicious invasive species Eurasian Water Milfoil
- and the overall degrading of the lake environment

These are the exact kinds of problems that fall under the Public Trust Doctrine that the DEC is entrusted to manage for our lakes and rivers.

Our research led us to Clean-Flo; a Pennsylvania company with a sound track record of success in reversing eutrophication and all of its symptoms. This science-based company is leading the field in reversing eutrophication in lakes around the world.

Armed with our new understanding of these modern technologies for reversing the effects of eutrophication, we urged Vermont DEC to engage with and understand what this innovative company was doing, and we applied to implement their multi-pronged solution at Little Lake St Catherine in the spring of 2011.

The DEC denied us permission to implement these new innovations, which in their full form include the use of EPA approved beneficial microbes and organic enzymes along with an oxygenation system. (Kind of like a probiotic for your ailing lake.)

Under sustained pressure from the LSCCF and some political friends, the DEC eventually relented and issued us a permit (in early 2012) for partial implementation of one part of the solution which is an oxygen restoration system which the DEC categorized as "aeration". The total bio-augmentation solution is much more than simply aeration.

We knew from conversations with the engineers at Clean-Flo that installing one of three components of a total solution in only 10% of the lake was unlikely to deliver the results that we hoped for.

Nevertheless, in hope of beginning down the road for a long-term, natural, holistic solution to the problems that plagued our Little Lake, as a community, we raised the funds needed to do what DEC would let us do. With 100% volunteer labor the LSCCF installed the system according to the manufacturer's specifications. This was July of 2012.

I'd like to make an important point: the work we are doing on Little Lake has the full support of the residents of the town of Wells, not only with their words of praise for the improvements they've seen in the lake, but also with their tax dollars. The voters of Wells have voted six years in a row to help fund our projects to the tune of over \$110,000, and our membership and directors have contributed over \$142,000 out of their own pockets to keep this and other projects running. That's a quarter of a million dollars in local funding. More than 150 homes line the shores of our lake, and lake residences make up the majority of the property tax base for the Town of Wells. Little Lake is also home to the Town Park with kayak launch, beach, and swimming area. Without question, the lake draws tourism from NY, CT, NJ, MA and other surrounding states and is the economic heart of the community.

Some facts about our project (and I know I have a lot of information here... I don't intend to go into detail. I can provide detailed reports for any committee members who would like them.)

According to the DEC permit that we were issued, we were required to do the following extensive data collection and monitoring weekly. Including, but not limited to:

- Suspended solids
- Total Phosphorus
- Nitrogen
- Chlorophyll
- D.O. (Dissolved Oxygen)
- and of course depth readings, at all 12 diffuser locations as well as 4 mid-point locations within the aeration zone and one control point several hundred yards outside of the aeration zone.

In total, we monitored over 32 data collection points on a weekly basis for the first few years and then were allowed to monitor monthly. All of this required an enormous effort with hundreds of volunteer hours. (There is probably not a larger collection of data points on any other lake in Vermont – except maybe Lake Champlain.)

Our objective was to accelerate the rate of decomposition and deepen the lake. As you can see, our data shows that the project is achieving its stated objective.

Here is a look at our depth readings. Charted out over a 5-year span, as you can clearly see we have gained significant depth in the aeration zone, an average of 54 inches at diffuser locations and an average of 49.5 inches at the midpoint locations (which are approximately 100 feet away from any of the diffusers.)

In 2015 we applied for and received a permit from the DEC for an expansion of the system to the west side of Little Lake. In this new permit the DEC sited multiple times there have been no negative environmental impacts from the east side aeration project, as our data clearly showed that the aeration systems were not causing any negative impacts to the lake environment... And clearly the lake was getting deeper.

I have an important point to make about depth measurements: the depth measurements taken by the LSCCF are the only depth measurements ever taken on Little Lake that have a benchmark reading as a point of reference of lake water level on Lake Saint Catherine. Let me repeat that: the depth measurements taken by the LSCCF are the only depth measurements ever taken on Little Lake that have a benchmark reading as a point of reference of water level. Historically, Lake Saint Catherine's water level has fluctuated from as much as 16 inches above the mean water level to a low of 10 inches below that mean. Consequently, any lake depth measurements without a benchmark measurement are worthless for determining accurate lake depth at any given point in time or change in lake depth over time. I'm going to come back to this point.

I'd like to show you some pictures of the east side of Little Lake Saint Catherine before and after the implementation of the aeration system.

Clearly, the lake had dramatically improved since aeration started in 2012, and for those of us who live on the lake as year-round residents, the changes were astounding. Frogs that had been gone since the chemical treatments were back the second year into aeration. The snails and crayfish were abundant again. Fishermen reported and continue to report the best fishing they have ever had in the Little Lake. Spawning areas have opened up as the muck as receded from a large portion of the east shore near the aeration zone, and a notable decline in the epidemic levels of submerged vegetation is happening – including a decline in Eurasian Water Milfoil.

Could aeration actually be causing a decline in Eurasian Water Milfoil? We wanted to know what the scientists had to say about that.

So, we dove into further research to find evidence of the effects of aeration on the reduction of Eurasian Water Milfoil. And what did we find? We found Dr. Jennifer Jermalowicz-Jones, of Restorative Lake Sciences in Spring Lake, Michigan. Dr. Jones is a Professional Limnologist and a Certified Professional Watershed Manager.

For over a decade, Dr. Jones has been studying laminar flow bio-augmentation technologies and its effects on not only muck reduction but also its impact on the reduction of Eurasian Water Milfoil. Dr. Jones is also a scheduled speaker at this year's North American Lake Management Society conference to be held in Burlington – she will be speaking on this exact topic.

Here is what Dr. Jones has to say about the effects of aeration on EWM. And I quote:

"Laminar Flow Aeration has proven itself as a useful lake improvement tool for reducing organic matter (muck) and also sedimentary ammonia in the sediments. The latter has led to a reduction in rooted EWM which utilizes ammonia as a key food source. In addition, the removal of organic matter has led to increased water depths in previously shallowed areas. Laminar Flow Aeration is also showing great promise in water column nutrient reductions."

I have included a prominent lake study by Dr. Jennifer Jones that documents reductions in both lake sediments and EWM. I've previously shared these studies; as with other significant research the LSCCF has done over the years with DEC officials.

I urge this committee to encourage the DEC and ANR to investigate this research. In my humble opinion, it is unconscionable to continue to rely on risky chemicals for combating EWM when clearly there are promising alternatives that need exploring, and a pilot project – albeit with significant DEC-imposed limitations – has been underway in Little Lake for the past six years, yet no one at DEC or ANR seems interested in participating in this research.

DEC claims that the aeration project on Little Lake is not producing results – is not deepening the lake – and is not having a positive effect on Little Lake. And, since the DEC did not do any of the weekly, monthly, or yearly data collection and observation, they base their claim largely on a sonar scan that was done by the DEC in 2018. And here is an image of that scan.

There are a couple of critical problems with this DEC scan. First, the BioBase Automated Mapping Cloud Platform used to create this map has quite a lot to say about the inaccuracy of the sonar scans in shallow lake environments in their operator literature. I've included a more detailed report from the company in my submission.

But I will share with you an excerpt from the second page of the report – and I quote:

“Just like regular statistical models, the type, quality, and amount of data going into the interpolation model determine the quality and accuracy of the map output. So, if you can't get a good sonar reading in a shallow, weedy bay, EcoSound may automatically "cleanse" the sonar return data during processing and the map produced (if any) may be based on insufficient input and not accurate. There are a variety of reasons why data may be cleansed by EcoSound and one of those is over vegetation greater than 60% biovolume.”

The scan that the DEC did to create this map you're looking at was done during the late summer season of 2018 at the absolute height of vegetation growth in the lake.

The second critical problem with this map is that there was no benchmark reading taken the day of the scan – or ever, for that matter – by the DEC. (I touched on this earlier. The LSCCF is the only entity that has ever established benchmark water level readings for this lake when engaged with depth measurements.) Therefore, this map is virtually worthless – unless you want to assume that BioBase's internal algorithm interpreted enough data points to extrapolate some kind of general measurement to soft bottom (even though we know we had a lake full of the vegetation at the time of the scan).

But if we do make this leap of faith, we can use the map to compare some parts of the lake with others and we can certainly see if any parts of the lake are deeper. And, lo and behold, we find that the east side aeration zone area is the deepest part of the little lake according to the DEC scan. Six feet of depth in much of the aeration zone.

Yet, the DEC claims that the aeration system in Little Lake St. Catherine is not having any positive effect, and the lake is not getting any deeper. They have gone on to say in correspondence with our association that they have historical data that shows that little lake has always been a 4 and 5-foot deep lake and it still is a 4 and 5-foot deep lake.

In response to their inadequate scan, the LSCCF contracted with an experienced BioBase mapping company to have an accurate scan done under the proper conditions. This scan that I now show you was done just eight days ago right after ice-out when you have the least amount of vegetation in the water column. Prior to the scan, a benchmark water level reading was taken at the concrete dam abutment at the south end of the lake. This scan can now be used going forward as an accurate BioBase scan that is in itself a benchmark to measure future change against. The LSCCF will be doing these scans every April.

As you can see, this eight-day-old scan shows that we have depths of over 7.5 feet in the aeration zone. As DEC has pointed out, this lake has been documented to be 4 and 5 feet deep for decades. With 7-foot readings in the aeration zone, clearly, the aeration project is deepening the lake.

A bit more on the BioBase system. It is vital to understand that sonar scans of shallow lakes will never give you accurate numbers in a soft bottom environment. It is not until you have a substantial hard bottom that you will have true bottom readings in a shallow lake. See the report on BioBase mapping included with my submission. The usefulness of the BioBase map that the LSCCF has produced is for going forward. We now clearly have a benchmark map to work from and can measure progress with this state of the art technology.

In light of DEC's claims that "aeration doesn't work" and rather than argue about Phosphorus and "aeration" and reversing the effects of eutrophication with VT DEC, we decided to seek the opinion of the top expert in the world on Cyanobacteria.

Professor Wayne Carmichael is recognized as the top global expert in Cyanobacteria and it was he who first established that Cyanobacteria were the organisms responsible for producing toxins.

Professor Carmichael is the founder of the International Conference on Toxic Cyanobacteria and staged and hosted the first three conferences at Wright University in Ohio. He has consulted to CDC, United Nations, World Health Organization, etc. He cannot be here today because he is in Europe preparing for the 11th International Conference on Toxic Cyanobacteria.

We sent Professor Carmichael a copy of the VT DEC's 2019 report titled "Aeration as a Lake Management Tool and Its Use in Vermont" and asked his opinion. He sent a written response in view of his commitments in Poland at the ICTC. I've included his full letter in my submission. Please take a moment to read his full response. I'd like to share some of Professor Carmichael's key remarks.

"I do not agree that there is no support for air flow methods that lead to reduction of accumulated organic matter on a lake's bottom (page 5, paragraph 4 of DEC's report). There are methods using air/water flow, complemented with bioaugmentation that will reduce and remove lake sediments and that will meet all 7 criteria, for permitting future aeration projects, as given on page 31 of the VT DEC (Jan 2019) document."

"Eutrophication is a whole lake process. It is multi-faceted, with numerous factors that can drive the process. Attempts to manage eutrophication that are focused on just one or two factors, and/or are not implemented on a whole lake basis are ineffective."

"One of the end results of failure to reverse eutrophication will be reduced water quality leading to cyanoHAB dominance. This is evidenced by significant examples such as Lake Erie and Lake Tai in China. Failure to mitigate eutrophication resulted in the Toledo situation in 2014. Similar fates will most likely occur in Lake St Catherine and Lake Carmi."

So, what does all of this mean? It means this: there are new, innovative, modern-day solutions to the consequences of eutrophication being successfully used around the world and around this country, and the 180-acre water-body known as Little Lake Saint Catherine has been running a successful project testing a portion of these new technologies for the past six years with extremely positive results. In the coming weeks, the LSCCF intends to file an application with the DEC for a continuation and expansion of the aeration project on Little Lake, and our request of this committee is for your full support of this application.

Oxygenation with bio-augmentation is clearly reversing the effects of eutrophication in water-bodies around the world. There is a lot more for the DEC to learn about these promising technologies and Little Lake is a great place to learn it.

We urge this committee to recommend to the DEC that the aeration project in little lake be allowed to continue and furthermore that this project be turned into a complete, whole-lake bio-augmentation project for the purposes of tracking this new technology's ability to reverse the negative effects of eutrophication and its endpoint, Cyanobacteria. And if indeed the added benefit of ammonia denitrification in lake sediments is responsible for dramatic reductions in EWM populations.

The LSCCF and the residents of the Town Of Wells and others are fully committed to raising the funds for this project. However, we propose that this project be monitored by a collective effort from DEC staff, scientists like professor Wayne Carmichael and Dr. Jennifer Jones, conservation fund volunteers. Results from this project have far-reaching implications for other lakes in the State of Vermont. A true partnership done the Vermont way with community involvement.

Little Lake has the potential to be a shining jewel for the State of Vermont to hold up as the way of the future for lake restoration, cyanobacteria mitigation, and EWM reduction. Let Vermont lead the way for holistic, sustainable, environmentally-friendly lake restoration, and lake

management. And let us leave a legacy to our children and grandchildren of clean, healthy lakes that can be enjoyed for generations to come.

Please stop them from shutting us down.

I appreciate your time today. Please dig into the extra information I provided for you with my presentation. I promise you there are things in there you need to read. I am available for any and all follow-up at: dave7vt@gmail.com and by phone: 802-236-2566

I'll be happy to answer any questions.