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What Works

Do You Want Something **That Works?**

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Do You Want Something That Works?

This question is too seldom asked when applied to lake management. The profession of lake management has been around for about 35 years and has evolved to a point where we have an obligation to be critical, systematic, and scientific in our approach. There are many tools, techniques, and approaches that (a) work well but are not used or (b) are unproven, yet are used. Here I review lake management approaches that work and lake management approaches that are not ready for prime time as a result of insufficient or inadequate testing.

Do You Want Something That Works?

This was the question my physician asked me when I asked if there were alternatives to pills for managing my high blood pressure.

I had been seeing Doc Lenay for about 25 years and he knew I preferred to manage my health in ways that I could control versus taking medications. For health concerns I had confronted prior to this, I made lifestyle changes that worked. Now, confronted with hypertension with no proximal cause or underlying pathology, he advised that "pills" were the only solution that worked.

I had checked Internet sources in advance of my appointment. I knew that high blood pressure was not good for me. I investigated alternative, non-pill remedies and found a few that offered certain assurances, but nothing definitive. More importantly, I lacked the knowledge, background, training, and expertise to fully evaluate any of these remedies. So in the end, I trusted Doc Lenay, a credible health care manager. After all, it was his business to know the literature and field and I was an amateur, albeit one with a substantial vested interest in the outcome. I (literally) swallowed the pill and my blood pressure is now normal.

My profession is managing lakes. Seldom does anyone ask me "what works?" Those involved in managing lakes have become less demanding of outcomes and more concerned about what are the acceptable, correct, popular, or expedient methods. Our lake management institutions are charged with managing (through regulations, funding, education, etc.) issues, but not resolving them – a serious flaw in the system. Our lake management profession has an obligation to change this.

For the most part, we have the tools to manage lakes for positive outcomes. My concern is that many lake managers as well as our clients and stakeholders too often set aside these tools for approaches that appear preferable. Lake management feasibility should involve assessments of applicability and reliability first, followed by evaluation of costs and regulatory acceptability. And, we must seek and expect real, physical outcomes in the lakes we manage.

Here I intend (a) to provide a screening tool for those confronting lake management challenges and (b) to stimulate a critical conversation about our profession's approach to managing lakes.

Status Quo

Many lake managers and those we serve seem to want:

- What is politically acceptable
- Popular
- Pixie dust
- Magic pills
- Silver bullets
- Quick fixes
- Natural remedies
- Non-chemical remedies
- Cheap or affordable remedies

However, we seem to not want or to know what works and what does not work, or even how best to facilitate or evaluate success. We have become lax on standards of care and due diligence as well as proper planning principles.

The result is that we too often lack positive outcomes, we have engendered a proliferation of tools, techniques, and approaches that are untested or unreliable, and we have set aside tried-and-true methods that do work, even though they sometimes offend certain lake users or regulators for various reasons that may not hold up under scrutiny.

What Works?

I propose a screening tool for whether or to what extent a particular lake management approach or technique works for common lake problems using a two-tiered approach to evaluate categorical lake management techniques based on applicability and reliability.

This evaluation is based on my knowledge of the literature and extensive field experience. I hope to stimulate a discussion, consider constructive input, and then follow this up with a additional analysis if warranted.

Applicability

Is this technique, approach, or method applicable?

High Applicable to the stated problem(s) to be managed, mechanism or mode of action is understood, risks are well known and minimal.

Medium In between.

Low Not applicable to the stated problem(s), unknown mechanism or mode of action, non-target impacts likely or unacceptable level of risks.

Reliability

The efficacy, reliability, and repeatability of lake management categories are evaluated as follows:

High Efficacy, reliability, and repeatability well established in peer-reviewed literature relative to the science that supports its applicability. Track record demonstrates positive outcomes.

Medium Efficacy, reliability, and repeatability established in a sufficient number of case studies evaluated by third-party, independent assessments using pre- and post-data to indicate a likelihood of positive outcomes

Low Efficacy, reliability, and repeatability not clearly demonstrated or only claimed by potentially biased sources. Additional assessment may improve this rating, but success not clearly expected based on available information.

Untested Efficacy, reliability, and repeatability not established due to lack of or insufficiency of reported testing. Commercials and testimonials do not count as documentation of positive outcomes.

This matrix is used as a quick reference for what works or not (color coding added):

	Reliability			
Applicability	High	Medium	Low	Untested
High	Works	Probably works	May work (beware)	Not recommended
Medium	Probably works	May work (beware)	Unlikely to work	Not recommended
Low	Not recommended	Not recommended	Not recommended	Not recommended

The meaning of these classifications is

Works When applied in appropriate situations, this approach or technique provides predictable and measurable outcomes with a high level of reliability.

Probably works When applied in appropriate situations, this approach or technique provides predictable and measurable outcomes with a reasonable level of reliability.

May work (beware) When applied in appropriate situations, this approach or technique may provide measurable outcomes, albeit with a low level of reliability.

Unlikely to work	This approach or technique is not likely to provide reliable outcomes.
Not recommended	This approach or technique cannot be recommended because it has unknown efficacy or it has not been tested (or both).

In addition, I have included ratings for the duration of benefits and maintenance requirements, as follows:

Duration of Benefits

Long	Multiple seasons or years.
Medium	About a season or year.
Short	Less than a month.

Maintenance Requirements

Continuous	Continuous operation or application required for benefits.
Frequent	Application required once or more per season.
Seasonal	Application required about once each season.
Occasional	Periodic reapplications are required to maintain benefits.
Rare	Applications should last for decades.

Lake Management Problems

For the ranking of what works, I consider common lake problems to be managed in these categories:

- Eutrophication, phosphorus impairments, and nuisance algae
- Nuisance (native) plants
- Aquatic invasive species (AIS) – Prevention
- AIS – Plant control
- AIS – Animal control

What Works / What Does Not Work?

Algaecides. Algaecides are chemicals that kill algae and have been in use for many years. Algaecide's efficacy tends to be short-lived and there are cases where algae, especially blue-green algae, have become resistant to algaecide treatments. The duration of effectiveness is short (weeks) and frequent repeated applications are typically indicated. The most commonly used algaecides are copper compounds.

	Reliability	Applicability	Rating	Duration	Maintenance
Eutrophication	High	High	Works	Short	Frequent
Nuisance native plants	n/a	n/a	n/a	n/a	n/a
AIS – Prevention	n/a	n/a	n/a	n/a	n/a
AIS – Plants	n/a	n/a	n/a	n/a	n/a
AIS – Animals	n/a	n/a	n/a	n/a	n/a

Artificial Circulation. Artificial circulation uses machines, usually bubblers or circulators, to extend the depth or duration of water circulation. Artificial circulation is not for the timid – it requires serious engineering, appropriate equipment, adequate power, and funding. When applied uncritically or lacking adequate diagnostics, engineering, or power, artificial circulation is neither reliable nor applicable and can sometimes do harm. There are many cases where artificial circulation is misapplied or applied to inappropriate problems. And sometimes, artificial circulation has been shown to harm lakes. In many of these cases, this technique is recommended based mainly on testimonials. It amazes me that people like seeing bubbles in their lakes. I am not aware of any cases where artificial circulation has been effective in control native or invasive plants. Below, reliability and applicability for eutrophication control are "high" in cases where artificial circulation is applied critically and appropriately, but "low" in cases where artificial circulation is applied uncritically.

	Reliability	Applicability	Rating	Duration	Maintenance
Eutrophication	High	High	Works	Long	Continuous
"poor application"	Low	Low	Not recommended	n/a	n/a
Nuisance native plants	Low	Low	Not recommended	n/a	n/a
AIS – Prevention	n/a	n/a	n/a	n/a	n/a
AIS – Plants	Low	Low	Not recommended	n/a	n/a
AIS – Animals	n/a	n/a	n/a	n/a	n/a

Biocontrols. Biocontrols are biological agents deployed to control unwanted invasive plants or animals. Here, biocontrols refer to a single control species (or sometimes a virus) applied to control a single target species. What little evaluation that has been done has, with few exceptions, been equivocal. There is a fundamental biological limitation to this approach as predators or control agents do not eliminate their prey or hosts, so oscillating cycles are common, making this technique generally unreliable.

Grass carp are known to control native and invasive plants, however, they tend to be indiscriminant and can eliminate all plants. This unintended impact limits the applicability of grass carp in some cases.

	Reliability	Applicability	Rating	Duration	Maintenance
Eutrophication	Untested	Low	Not recommended	n/a	n/a
Nuisance native plants	Untested	Low	Not recommended	n/a	n/a
AIS – Prevention	n/a	n/a	n/a	n/a	n/a
AIS – Plants	Low	Medium	Unlikely to work	Medium	Seasonal
AIS – Plants (Grass Carp)	High	Medium	Probably works	Long	Occasional
AIS – Animals	Untested	Low	Not recommended	n/a	n/a

Biomanipulation. Biomanipulation refers to manipulations aimed at multiple links in the food chain. Manipulations can involve physical manipulations or the stocking of predators or herbivores. The efficacy, reliability, and repeatability of biomanipulation increases with decreased phosphorus levels in lakes; that is, it is most effective when least required. There are documented cases where biomanipulation works well, however these involve ongoing maintenance and inputs of energy. As an ongoing endeavor, long-term evaluations have a less complete record of documentation.

	Reliability	Applicability	Rating	Duration	Maintenance
Eutrophication	High	Medium	May work (beware)	Medium	Occasional
" poor application	Low	Low	Not recommended	Medium	Seasonal
Nuisance native plants	Low	Low	Not recommended	n/a	n/a
AIS – Prevention	n/a	n/a	n/a	n/a	n/a
AIS – Plants	n/a	Low	Not recommended	n/a	n/a
AIS – Animals	Low	Low	Not recommended	n/a	n/a

Drawdown. Lake drawdowns require the ability to drain large volumes of water for extended periods of time. This is impractical in many cases or may have unacceptable non-target impacts, so acceptability may be low. When accomplished, winter drawdown in northern lakes exposes shallow sediments thereby desiccating or freezing plants. Many rooted plants will be controlled for multiple seasons, however, plant species that germinate from seeds annually may increase following a drawdown. Invasive plants may be controlled, but the applicability is appropriate when invasive plants dominate the plant community. In cases where phosphorus is mobilized from shallow sediments, drawdown may also mitigate internal phosphorus inputs, but decomposition of sediment may release additional nutrients.

	Reliability	Applicability	Rating	Duration	Maintenance
Eutrophication	Medium	Medium	May work (beware)	Medium	Occasional
Nuisance native plants	Medium	Medium	May work (beware)	Medium	Occasional
AIS – Prevention	n/a	n/a	n/a	n/a	n/a
AIS – Plants	Medium	Medium	Probably works	n/a	n/a
AIS – Animals	Low	Low	Not recommended	n/a	n/a

Dredging. Dredging (with removal) deep lake sediments has multiple benefits, including the removal of nutrient-enriched sediments and the deepening of the lake. As a result, internal phosphorus recycling may be diminished and more of the lake bottom will be uninhabitable for rooted plants. While dredging may be considered perhaps the only true lake restoration technique, it is, unfortunately, very expensive and therefore not always feasible.

	Reliability	Applicability	Rating	Duration	Maintenance
Eutrophication	High	Medium	Probably works	Long	Rare
Nuisance native plants	Medium	Medium	May work (beware)	Medium	Occasional
AIS – Prevention	n/a	n/a	n/a	n/a	n/a
AIS – Plants	Medium	Medium	May work (beware)	Medium	Occasional
AIS – Animals	Low	Low	Not recommended	n/a	n/a

Herbicides. Herbicides are chemicals that kill unwanted plants (algaecides are considered above). There are about a dozen commonly available herbicides in use. Some herbicides are non-specific, killing all (or most) nuisance plants in the treatment area and some herbicides are selective, targeting nuisance plants while leaving non-target plants unharmed. Some herbicide applications are meant to treat specific areas within a lake, either because they are non-selective and there is value to protecting plant stands or because plant nuisances may occur in specific areas of the lake. Some herbicide applications are meant to control larger areas, perhaps including the entire lake, but these should be selective to assure non-target plants are unharmed. Herbicides may not always be applicable, but with proper planning and application, reliability will be high.

	Reliability	Applicability	Rating	Duration	Maintenance
Eutrophication	n/a	n/a	n/a	n/a	n/a
Nuisance native plants	High	High	Works	Medium	Seasonal
AIS – Prevention	n/a	n/a	n/a	n/a	n/a
AIS – Plants	High	High	Works	Medium	Seasonal
AIS – Animals	n/a	n/a	n/a	n/a	n/a

Mechanical Removal. Nuisance plants and animals may be physically removed by various methods. Nuisance floating algae may be removed by skimmers; nuisance rooted plants may be pulled, cut (with or without collection), harvested, rototilled, or via diver-assisted suction dredging; and nuisance animals may be collected by various methods. In most cases, mechanical removal will be very effective, at least to the extent the offending plants or animals are removed. In most cases, sufficient numbers or amounts of biomass is challenging to remove and regrowth, repopulation is often rapid. Removal of AIS animals is ineffective, except possibly for common carp.

	Reliability	Applicability	Rating	Duration	Maintenance
Eutrophication	High	Medium	May work (beware)	Short	Frequent
Nuisance native plants	High	Medium	Probably works	Medium	Frequent
AIS – Prevention	n/a	n/a	n/a	n/a	n/a
AIS – Plants	Medium	Low	May work (beware)	Medium	Frequent
AIS – Animals	Low	Low	Not recommended	n/a	n/a
AIS – Common carp	Medium	Medium	May work (beware)	Long	Occasional

Microbes and Enzymes. Microbes and bacterial concoctions, sometimes augmented with enzymes, promise to facilitate algae control or nutrient manipulations. I am aware of no objective documentation of position outcomes. Successes claim to have been achieved, but most ingredients are proprietary and it is likely that much of the effectiveness on algae relates to algaecidal properties that would require the need for registration as a pesticide, something venders would wish to avoid. Most claims of efficacy lack objective, third-party evaluations. A newly registered bacterial product, ZequanoxTM, claims to control zebra and quagga mussel in areas of lakes, however as of this time, there are no objective studies.

	Reliability	Applicability	Rating	Duration	Maintenance
Eutrophication	Untested	Low	Not recommended	n/a	n/a
Nuisance native plants	Untested	Low	Not recommended	n/a	n/a
AIS – Prevention	n/a	n/a	n/a	n/a	n/a
AIS – Plants	Untested	Low	Not recommended	n/a	n/a
AIS – Animals	Low	Unknown	Not recommended	n/a	n/a

Oxygenation. Oxygenation is a kind of aeration that adds concentrated oxygen to the lake water, which provides increased habitat and limits (but does not always eliminate) internal phosphorus recycling. This is most often added below the thermocline, called hypolimnetic aeration, using highly specialized equipment. Oxygenation requires specialized equipment, careful planning, proper design, and precise implementation. When low dissolved oxygen is an issue, many problems can be mitigated by adding oxygen to deeper water.

	Reliability	Applicability	Rating	Duration	Maintenance
Eutrophication	High	High	Works	Long	Continuous
Nuisance native plants	n/a	n/a	n/a	n/a	n/a
AIS – Prevention	n/a	n/a	n/a	n/a	n/a
AIS – Plants	n/a	n/a	n/a	n/a	n/a
AIS – Animals	n/a	n/a	n/a	n/a	n/a

Public Education. Public education is perhaps the most recommended, most used management approach and it is also the least objectively studied. The reliability of public education is "low" in the context of evaluating measurable, tangible outcomes of direct results or lake condition. Similarly, the expectations of positive outcomes are substantially unknown due to the lack of objective evaluation. For the most part, public education is applied uncritically – it is viewed as the right thing to do, often considered sufficient on its own to mitigate problems, but least documented in terms of actual results. More studies by social scientists are showing it is possible under some circumstances to change attitudes and sometimes behaviors, however I am aware of no documented beneficial outcomes in terms of lake condition or positive departures from a known baseline condition.

Public education undoubtedly has merits, it is just insufficient to recommend with the expectation for measurable outcomes in lakes.

	Reliability	Applicability	Rating	Duration	Maintenance
Eutrophication	Low	Low	Not recommended	n/a	n/a
Nuisance native plants	n/a	n/a	n/a	n/a	n/a
AIS – Prevention	Low	Low	Not recommended	n/a	n/a
AIS – Plants	n/a	n/a	n/a	n/a	n/a
AIS – Animals	n/a	n/a	n/a	n/a	n/a

Watershed Management. Watershed management includes best management practices (BMPS, e.g. rain gardens, ponding, street sweeping). Watershed management is the predominant lake management paradigm in use today (at least for eutrophication issues). This is based on the presumption that the ultimate source of offending phosphorus is delivered from a lake's tributary watershed. While this is strictly accurate, with minor exceptions (such as atmospheric or groundwater sources), it often does not follow that reducing these sources will lead to improvements in lake condition. In addition, the phosphorus reduction of many BMPs is insufficient.

Here are some factors to bolster this argument:

- Eutrophic or impaired lakes often have lost their resilience to phosphorus reductions, meaning there are unresponsive or will take a very long time (decades, centuries) to respond.
- Watershed phosphorus sources are typically 10-times or greater compared to the background loading rates required to sustain an improved lake condition, while BMP performance seldom exceeds 50% reductions. BMPs are also costly to install and maintain.
- It is extremely challenging (requiring large-scale land conversions) and expensive (often tens to hundreds of millions of dollars) to mitigate excess phosphorus in urban and agricultural watersheds.
- An implied requirement of comprehensive BMP implementation is that all parties, properties, and stakeholders will implement, maintain, and monitor BMPs. This seldom happens.

The percentage of documented watershed projects that have mitigated known phosphorus impairments is extremely low.

On the other hand, watershed management designed to protect an un-impaired lake may be effective. Unfortunately examples are rare, but this approach in this situation has promise, especially for small watersheds (not exceed about 10-times the lake's surface area) that still have significant areas undeveloped.

I often hear watershed management advocated for its prevention benefits for aquatic plant problems, but I am not aware of any documentation that watershed runoff is either a cause or a remedy for plant nuisances.

Watershed management is always appropriate and beneficial (especially for non-phosphorus pollutants), but is too often insufficient or unreliable for mitigating phosphorus impairments in lakes.

	Reliability	Applicability	Rating	Duration	Maintenance
Eutrophication (mitigation)	Low	Medium	Unlikely to work	n/a	n/a
Eutrophication (protection)	High	Medium	Probably works	Long	Occasional
Nuisance native plants	Low	Low	Not recommended	n/a	n/a
AIS – Prevention	n/a	n/a	n/a	n/a	n/a
AIS – Plants	n/a	n/a	n/a	n/a	n/a
AIS – Animals	n/a	n/a	n/a	n/a	n/a

Phosphorus Precipitants – Alum Compounds (PP-Alum). Aluminum compounds, especially aluminum sulfate (alum), have a long documented record of effective treatments to mitigate excess phosphorus through one of these approaches: phosphorus water column stripping, phosphorus inactivation, phosphorus interception, and phosphorus maintenance. Early concerns with toxicity have been solved with appropriate implementation. Dose calculations must be done properly, but success is undeniable. Duration and maintenance vary depending on application strategy.

	Reliability	Applicability	Rating	Duration	Maintenance
Eutrophication	High	High	Works	Variable	Variable
Nuisance native plants	n/a	n/a	n/a	n/a	n/a
AIS – Prevention	n/a	n/a	n/a	n/a	n/a
AIS – Plants	n/a	n/a	n/a	n/a	n/a
AIS – Animals	n/a	n/a	n/a	n/a	n/a

Phosphorus Precipitants – Calcium & Iron (PP-Ca & Fe). Phosphorus precipitation using other metal salts, particularly calcium or iron has a long documented record of effective treatments to mitigate excess phosphorus in appropriate situations. The biggest drawbacks are the effects of pH and oxygen, which limit applicability. Where applicable, positive outcomes are reliable

	Reliability	Applicability	Rating	Duration	Maintenance
Eutrophication	High	Medium	Probably works	Variable	Variable
Nuisance native plants	n/a	n/a	n/a	n/a	n/a
AIS – Prevention	n/a	n/a	n/a	n/a	n/a
AIS – Plants	n/a	n/a	n/a	n/a	n/a
AIS – Animals	n/a	n/a	n/a	n/a	n/a

Phosphorus Precipitants – Other (PP-Other). There are newer products available with claims they are effective phosphorus precipitants. Examples include BaraclearTM (aluminum sulfate, sodium bentonite and calcium carbonate), PhoslockTM (lanthanum) and SeClearTM (algaecide with unspecified metal salt). I am aware of no peer-reviewed, third party evaluations or field trails and the track record is too limited to draw conclusions. With proper evaluation, some of these could be reliable where appropriate, although costs may be high.

	Reliability	Applicability	Rating	Duration	Maintenance
Eutrophication	Untested	Medium	Not Recommended	n/a	n/a
Nuisance native plants	n/a	n/a	n/a	n/a	n/a
AIS – Prevention	n/a	n/a	n/a	n/a	n/a
AIS – Plants	n/a	n/a	n/a	n/a	n/a
AIS – Animals	n/a	n/a	n/a	n/a	n/a

Summary

Below is a summary. If a particular lake management category is not listed, that means it is not applicable for that lake problem.

Eutrophication, phosphorus impairments and nuisance algae

Works or Probably Works
Algaecides
Artificial circulation (critical)*
Dredging
Oxygenation
Watershed management (protection)
PP-Alum
PP-Ca & Fe

May Work
Biomanipulation
Drawdown
Mechanical removal

Unlikely to Work or Not Recommended
Artificial circulation (uncritical)*
Biocontrols
Biomanipulation ("poor application")
Microbes and Enzymes
Watershed management (mitigation)
Public Education
PP-Other

* See description above

Nuisance (native) plants

Works or Probably Works
Herbicides
Mechanical removal

May Work
Drawdown
Dredging
Biomanipulation

Unlikely to Work or Not Recommended
Artificial circulation
Biocontrols
Microbes and Enzymes
Watershed management

Aquatic Invasive Species (AIS) – Prevention

Works or Probably Works

May Work

Unlikely to Work or Not Recommended
Public education

AIS – Plant Control

Works or Probably Works	*May Work*	*Unlikely to Work or Not Recommended*
Biocontrols (Grass Carp)	Dredging	Artificial circulation
Herbicides	Mechanical removal	Biocontrols
Drawdown		Biomanipulation
		Microbes and Enzymes

AIS – Animal Control

Works or Probably Works	*May Work*	*Unlikely to Work or Not Recommended*
	Mechanical removal (carp)	Biocontrols
		Biomanipulation
		Drawdown
		Dredging
		Mechanical removal
		Microbes and Enzymes

Discussion

This is meant as a screening tool and should not be used as to make final decisions. Methods that come through as "works," mean they should be further considered and evaluated. Methods listed as "probably," "may," etc., may still be considered, but greater care should be exercised as indicated in the definitions proposed above. It is essential to follow good planning steps. These include problem definition, diagnostics, modeling and feasibility assessment, setting measurable objectives, monitoring, and evaluation.

Of course a management tool or technique that "works" does not necessarily mean it should be used. A hammer "works," but should not be used for a screw.

Some lake problems are not addressed here, for example, shoreline degradation, water levels, surface use, etc. Similarly, some management techniques that do not neatly fit larger categories are not considered, such as barley straw or floating islands. Generally, techniques not included above have insufficient evaluation to warrant recommending their use.

Several interesting observations can be made:

First, there are a number of reliable, tried-and-true methods available for eutrophication controls. Many of these have become out of vogue far various reasons. Many contemporary lake management approaches are being tried because they are correct (e.g., public education, watershed management), they are sexy or natural (e.g., microbes, enzymes), they are non-chemical (e.g., bubblers) or they appear innovative (e.g., PP-Other). But these are largely untested (and therefore reliability is unknown) or ineffective.

Similarly for nuisance plant control, there are tried-and-true methods available and newer methods that tend to be ineffectual.

AIS-Prevention is an emerging problem with an immature suite of techniques and approaches. I know of no categorical approach that has been evaluated in a real field setting that demonstrates any kind of efficacy at preventing AIS introductions or establishment. A number of successes have been claimed and further documentation may better clarify the efficacy of these programs. Controlled studies are difficult to design, so providing an objective basis for guidance or evaluation will remain challenging.

We have gotten away from government or third-party demonstrations, which I think has put us in a poor position to evaluate new technologies. In this vacuum, new products have emerged to fill perceived needs, with venders and manufacturers providing self-evaluations. I have seen too many projects that have wasted time and money on techniques that yield minimal or no results.

Lack of federal, state, and often local funding have forced a desperate public to consider or use lake management techniques that are affordable. Unfortunately, these techniques are also largely ineffective. Our institutional approach emphasizes watershed management, has spent or caused to have spent hundreds of millions of dollars, yet our lakes remain impaired. And who doesn't like public education? Too bad we lack field studies demonstrating positive results in our lakes.

I hope and intend for this assessment to be reviewed critically and for those wanting to improve their lakes to help narrow and focus their efforts. I welcome critical reviews, but ask they be accompanied by credible support for contrary assessments.

Thanks to Ken Wagner, CLM, for his many helpful comments and insights on an earlier draft of this article.

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