

**Devils Lake Water Improvement District
Harmful Algal Blooms workshop
Oregon Coast Community College, Lincoln City, Oregon
April 19, 2014**

Workshop started at 10 a.m. Meeting room was packed with several dozen people. Standing room only inside, with others standing in the doorway.

Paul Robertson, Lake Manager:

Purpose of workshop is to get a better understanding of HABs as they relate to Devils Lake. Presentation meant to inform the public, board, staff about what can be done to address HABs. Decision not expected today, but board may be able to discuss what they would like to see done next.

Invited to speak today:

- Joe Eilers, professional hydrologist, certified lake manager, fish biologist, has done extensive work on Devils Lake, expert on Devils Lake data collection.
- John Fonseca, owner of Advanced Aquatics Solutions, company that treats lake water with an aeration technique

Robertson:

Reviewed website chart on HABs.

Today the algae bloom is gone, the lake is clear to 5 meters. No detectable toxins. All tested toxins are below detection limits. Samples taken from 10 sites.

Audience question:

Why wasn't lake tested when the bloom was visible? (Several questions along this line.)

Robertson:

Historically, the HABs testing has always started after Memorial Day, when the recreation season begins. Testing is expensive. In the future, District will probably test earlier, but resources are limited. Might have to budget for year-round testing.

A thorough test costs \$1,000 per sample (so sampling 10 sites would cost \$10,000). Could do a smaller test for around \$250. Some testing is done in-house but for a complete test, samples are sent to King County, Washington.

Showed slide of cell count test from a week ago; either no presence, or well below threshold. Clarity excellent at 17 feet. Oxygen level dropped when the algae bloom crashed but now rebounding. Tests show pH normal.

Audience question:

Did this kill fish?

Robertson:

3 dozen fish killed at Regatta Grounds. ODFW had just stocked fish the day before; fish may have died from stress of being put in lake during bloom; about 0.1% of the stocking died, so it was not extensive. Deaths were in only one spot.

Temperatures are normal. Lake level today is 9.36' above sea level (maximum impoundment is 9.53'). During the week of the bloom, the lake level was 9.75'.

Audience question:

Several audience members questioned notion that bloom ended over winter, since lake was green all winter.

Robertson:

Bloom actually ended in November 2013. The lake was delisted at that time. Cell counts were well below the threshold.

Audience question:

Was ODFW advised about the bloom?

Robertson:

ODFW knew about the bloom; 2000 fish were put in Regatta within an enclosure for the fishing derby; all lived. Fish kills are related to low oxygen, not to algae toxins, which would embed in fish but not kill them.

Reviewed slide presentation (available on website) showing history of lake, strategies to control weeds, history of contamination, algae. In the 1970s, considered the most polluted lake in state.

Solutions require a look at the additives, not just the outcomes. Weeds were once the main issue, because they dominated the lake.

Audience question:

Were nonnative plants intentionally planted?

Robertson:

Not to his knowledge. Spoke to history of bass introductions in lake.

Current lack of vegetation shows a system out of balance; less than 1% of the lake is vegetated. Explained sediment core testing and results; growth in nutrients coincides with growth in algae.

Audience question:

Should we monitor lake more frequently? Is there a plan for more testing?

Robertson:

The board will be considering additional monitoring

Joe Eilers:

Reviewed status of lake. Discussed pros and cons of high lake levels.

Pro – easier boat access, fewer exposed rocks, some insignificant dilution of nutrients that feed algae.

Con - greater shoreline erosion, greater inundation of septic fields (causing more nutrient loading), difficult to establish new wetlands.

Devils Lake is naturally lower in the summer, when boaters want it higher. Plants on shoreline prefer a fluctuating lake. Legal maximum is 9.53' above sea level. The concrete sill at the D River dam keeps the lake at 8.0'. Current range of fluctuation is only 1.5'.

Audience question:

Why resistance to raising lake level?

Robertson:

Biggest concern has been the shoreline.

Eilers:

Lowering the lake does reduce the dilution of nutrients, but does not necessarily lead to an increase in blue-green algae. The normal substantial rainfall on the coast (8 feet of rain a year) should flush the lake, move the nutrients out, and minimize the blue-green algae blooms.

Problem is that most of the inflow and outflow at the lake is at the south end (Rock Creek to D River), reducing the effective drainage of the lake.

Bigger issue is residence time, the amount of time that a quantity of water is allowed to remain in the lake without being flushed.

Audience question:

Do boat wakes cause more shoreline erosion?

Robertson:

You would expect more erosion during winter storms; summertime erosion is 20% of impact; entire shoreline erodes during summer; might be higher when the lake is high because we have more boaters.

Audience question:

Has recent logging in drainage basin had an effect on erosion?

Robertson:

Forest Practices Act intended to improve forestry behavior. It's complicated. Phosphorus loading is correlated with intense forest activity in a watershed.

Audience question:

Since 85% of the lake is protected by seawalls, does lowering the lake below its 10-year average increase erosion below the seawalls?

Eilers:

You will have increased erosion under extreme conditions; very high and very low levels would cause more erosion.

Audience question:

Could we target erosion mitigation for the 15% of the shoreline that is not protected?

Eilers:

Yes, there are a number of techniques to create offshore barriers.

Robertson:

One obstacle is that the state doesn't approve all seawalls. That's why we try to increase vegetation on the shoreline. Plants thrive better with a fluctuating shoreline.

Audience question:

Does 6" of water (9.0' or 9.5') have any effect on the algae?

Eilers:

No.

Audience question:

Save Our Shoreline is an excellent idea, but why promote spruces and willows? Spruces block the view and they're dangerous.

Audience question:

Question regarding septic tanks causing 20% of the nutrient load, and lake sediments trapping 50 years of nitrates. Question never really concluded.

John Fonseca, Advanced Aquatics Solutions

Reviewed his understanding of the lake; 100 years old, with a lot of nutrients, pollution. Comes from aquaculture field, view from fish perspective. Not focused on HABs. Works with Keeton Industries. Described aeration proposal. Rock Creek flow creates eddy, keeps north lake stagnant. Ecosystem not in balance. Biological oxygen demand not being met, forcing fish to surface for oxygen. High nutrient loading leads to algae blooms. Bottom of lake is dead, full of nutrients.

Aeration of lake bed through diffusers would bring bottom to life, increase oxygen level, make it habitable for plants and animals. No chemical additives. Uses microbial aides to enhance bacteria population, increase digestion.

Diffusers connect to tubing that extends through bottom of lake. Need 100,000 feet at \$1.30 per foot.

Better term for bottom of lake is "sludge," not just sediment. Need to mitigate with high biological oxygen level.

Suggests 20 aeration systems around lake. Each unit has four 1/3-horsepower compressors. Power cost estimate of \$180 per day, or \$18,648 a year. Plus filters, service, etc. Two-year warranty.

Current systems in use at 45 and 60 feet. Devils Lake is less. System in place at Large Lake, San Ramon CA (20 acres, 9 feet deep, 32 diffusers). Marin County reservoir had Solar Bees and was failing; Keeton diffusers in place across 100 acres.

Estimated cost for Devils Lake: \$400,000. Contact: aquafonseca@gmail.com

In response to questions:

Aeration will cause sludge on bottom to circulate, releasing phosphorus and other nutrients into the water. Initially, will produce odor. Addition of microorganisms will combat nutrients and odor. Bacteria program for this lake, very rough estimate, might start at \$30,000. Government permits not needed.

Robertson:

Government permits are required for anything you put in the lake.

Eilers:

Reviewed nutrient levels on lake in the 1990s and 2000s. Nitrate concentration unusually high. Phosphorus high. Chlorophyll concentration also high (causing green color in lake). To best manage lake, focus on phosphorus.

Audience question:

How long would it take for the nutrients in the lake to be meaningfully reduced if we put in a sewer system?

Eilers:

There would be a lag. When you look at lakes where we have turned off the nutrient-loading from external sources, it has taken sometimes 25 years to bleed the phosphorus concentrations out.

Natural state of the lake is to have a higher percentage of vegetation than we now have. Algae growth results when vegetation is reduced. Recommends a higher percentage, 10-20 percent of vegetation, and a much lower stocking rate of carp. Then monitor the return of the weeds.

With return of vegetation, we would expect bass, bluegill, crappie to return. That's one reason to keep vegetation down, because we would expect reduction of salmon smolts with the increase of those other fish.

Robertson (response to question):

District's overall budget from tax revenue is about \$225,000; currently have \$430,000 in reserve. Budgeted \$5,000 on testing last year.

Audience question:

Could we combine techniques and use aeration in the north end of the lake and natural hydrology to the south? Currently, the south end is clear, while the north end is green.

Eilers:

District is currently pursuing several parallel paths. You can absolutely combine aeration with other strategies. Aeration uses no chemicals; could do pilot study, incremental installation.

Fonseca:

Cited experience with bringing another lake into compliance in 12 months.

Audience question:

Do we know the levels of sewage that have spilled into the lake from the city?

Robertson:

City reports all to DEQ. The last spill was 65 gallons. The last spill to actually hit the lake was in 1997.

Kip Ward:

Does the dam interfere with the cycling of lake?

Eilers:

It does not appear to be.

Audience question:

Historically, the D River is much lower than it used to be.

Robertson:

Concrete sill is 8 feet above sea level; water still goes over it in the summer; started out with a fence to keep carp in, but logs came up D River on storm surge and ruined fence, so concrete put in. Concrete traps sand on the lake side.

Ward:

Would removing the dam increase the lake's ability to flush?

Eilers:

If the concrete sill has raised the base, then that's an issue.

Ward:

If vegetation grows on the sediment, will that will pull nutrients out of the sediment?

Eilers:

Probably yes.

Ward:

Why not let the vegetation grow and then mow it and harvest the weeds? Would that remove the sediment?

Eilers:

Perfectly correct. Paul has looked at the cost of weed harvesting.

Robertson:

Weed harvesting: \$250,000 per machine, need 3 to keep up with growth; run them all summer long. Would cost about a million dollars.

Ward:

Lots of contention regarding 6" of water. What is the environmental impact on lake?

Eilers:

6" fluctuation is not huge. To reestablish wetlands, need a more normal, larger swing; 6" fluctuation probably helpful but not optimal to establish vegetation; inconsequential to diluting

nutrients; 6” increase probably would not yield a measurable effect on wetlands or alter the erosion.

Eilers:

Options to reduce algae

Short term:

- let grass carp die and vegetation will return and compete with algae
- inactivate phosphorus with alum (\$2-\$3million, don't know how long that lasts; might not have long-term effect on shallow lake, very costly)
- increase flushing
- decrease residence time by letting lake drop to minimum level (better if lake goes down 50%, but can't do that with the concrete sill)
- increase shading with dyes, but you have to keep adding
- apply oxidants (hydrogen peroxide – kills cells of blue-green algae, but this releases toxins)
- aeration for circulation (Australians found aeration to be 60-65% effective, ineffective if not enough applied) (would recommend pilot study) (no need to add bacteria; lake already has adequate bacteria)
- introduce silver carp? (eats algae but won't be approved by ODFW)

Long term

- sewer lakeshore homes (all septic systems are feeding nutrients into the lake, whether or not they have failed)
- increase wetlands
- divert storm sewers (detention basins)
- eliminate yard use of fertilizer
- restore shoreline

Eilers has monitored Tenmile and other lakes on the coast. Septic loads increase over the summer when rains slow; do not underestimate impact from septic systems.

Wetlands: low-cost way to intercept nutrients coming into the lake. Map of storm drains into lake is not complete; could combine existing storm drain areas with swales to establish wetlands.

Reduce fertilizer; change vegetation choices.

Encourage you to think short-term but don't forget long-term or future generations will have to deal with it

Dredging has a very poor history of success with removing nutrients; leaves a lot behind.

Fonseca

Aeration: suggested starting with a bench study to analyze sediment (sludge). Diffusion will create immediate improvement by adding oxygen. Initial turbidity will clear soon.

Audience question:

Would like to know what board is considering.

Brian Green:

Joe has to finish his presentation; this is a workshop to consider ideas, not to commit to a plan.

Eilers:

We do not have enough data. Devils Lake is a managed lake and has to be from now on; 85% armored. Need more data to monitor inflows and outflows of nutrients. Can do numerical models, hydrodynamic models, determine where water is going, when and why; use that info to evaluate alternatives. Detailed nutrient, hydrological budget for one year for Devils Lake would cost about \$50,000.

Recommends considering pilot study of aeration on one of the lake arms. History suggests aeration has better than 50/50 chance of improving lake quality. Some other short-term ideas are too expensive, like alum, Phoslock. For long-term, continue thinking of future generations.

Audience question:

Is Joe Eilers the algae expert who was to be hired, based on a motion at the last meeting?

Robertson:

He is knowledgeable, but he was brought in to address the workshop.

Audience question:

What can we expect for the next five years regarding algae if no action is taken?

Eilers:

Nutrients will continue to increase, and so will the algal problems. Blue-green algae competes with green algae, diatoms and other organisms; last week you saw a huge bloom of anabaena and then a huge crash occurred; the crash occurred because of viral infection on anabaena. When the system crashes, different colors come out; green algae will then outcompete the blue-greens. There will be periods of time when nitrate concentrations become undetectable, that's when the blue-green algae thrive, because they fix nitrates from the atmosphere.

Audience question:

What conditions have changed to cause us to go from no significant algae three years ago to a terrible bloom this year?

Eilers:

Don't assume that the nutrient load has not changed. An increase in sewage would do it.

Green (in response to question):

The golf course has been allowed to take water from the lake in an effort to have it use less fertilizer, so there's less runoff to the lake.

Eilers (response to question):

We have known since the 1960s that viruses attack algae; attempts at applying viruses to fight algae have failed; the viruses are very specific to strains within the algae species; competing species evolve, giving us very little control over the use of the viruses

Audience question:

Since every lake is different, how do we know aeration will be effective? Aeration works in stratified lakes, but we don't have that; our waters mix from top to bottom. How do we test oxygen?

Robertson:

We use a simple probe to test oxygen at multiple sites, from top to bottom. Temperature is measured at D River and in the lake at different depths. The temperature is almost always within a couple of tenths of a degree centigrade.

Audience question:

Can we test thoroughly to establish the oxygen and phosphorus levels around the lake? What do we do short term to start attacking the algae?

Eilers:

Aeration is not intended to add oxygen; most of the time, the lake has enough oxygen. The objective is to increase circulation, which improves the habitat for vegetation and not for blue-green algae.

Green:

Asked Eilers what the timing would be on gathering data and starting a pilot aeration study.

Eilers:

Start with data-gathering to determine baseline; then start pilot aeration. Gathering data from May through November would give an adequate basis for proceeding with pilot aeration. You could monitor data and start a pilot at the same time; you could then collect comparative data by putting the pilot in one area of the lake and collecting data elsewhere.

Golf course supervisor (in response to question):

Golf course uses very little water in the summer; when we do use water, it's nutrient-rich water from the lake. We take water samples from multiple areas of the golf course, and they are well below EPA standards for nitrates and phosphates. Cannot say if fertilizer use has been reduced because he wasn't at golf course before 2011.

Green:

It will take time for permits, easements, for a pilot aeration study. We can start monitoring now, and maybe in a few months start the pilot aeration.

Audience question:

If lake manager and board were made aware of aeration some years ago, is that an indication that aeration was overlooked?

Robertson:

Some years ago, there was much interest in HABs, but attempts at attacking HABs were shot down by the existing board, including Mitchell Moore; then there was a change in the board, and Joe Barnes on the board said HABs was not a problem, so the focus was put on grass carp.

Audience question:

More important to look to the future than pointing fingers at the past.

Robertson:

We do have quite a bit of data, so we know we have too much phosphorus; monitoring was not continued because we didn't need to spend more money on monitoring.

Audience question:

Is it true that the lake is at its lowest level ever and the algae was its worst ever?

Green:

There's no evidence that the lower lake caused the algae bloom.

Robertson (in response to many random, repetitive comments about lake level):

Time to regroup; decision not to be made today

Mitch Moore:

Supported focusing energy on specific projects; people need you to raise lake in order to get their support; work with Devils Lake Neighborhood Association to calm down the dialogue; we exist to make your life easier; change messaging on septic – let's not say septic are failing or leaking; DLNA supports Save Our Shoreline, voluntary septic inspection, real estate inspection, erosion projects; all willing to help, but get past hot button of lake level and bad press over septic; DLWID did awesome job of creating long-term plans, but there needs to be a short-term plan; let's find 3 or 4 possible solutions, get experts in and get a realistic analysis of prospects.

Audience question:

Concern about not being able to put boats in lake because of the low level; almost had to pull boat from water with a crane because we couldn't get it off the lake; what is the problem with raising the lake?

Robertson:

Board tried to weigh all issues and compromised at 9 feet.

Dave Skirvin:

Let's have the board members summarize their views; we can talk about putting the lake level question on the May agenda.

Eilers (after further repetitive discussion of lake level):

To summarize, whether the lake is at 9.5' or 9.0', algae will not be affected in a meaningful way, but if you are interested in establishing wetlands around the lake, the plants will do better if you let the lake fluctuate more. Also, the higher the lake level, the more likely you are to draw nutrients out of the septic drain fields.

Audience questions:

Do we know what percentage of the septic fields will actually be affected? How much of a difference will the lower lake level really make, since it's low for just a short part of the year? How much vegetation will actually grow and where will it grow, since much of the lake is armored by seawall? Are the benefits from a lower lake worth the aggravation that is caused to the boat owners and the homeowners? Do we have enough data to make educated decisions?

Final comments

Ward:

None of us get paid, but we spend several hours a week exploring answers, often find that the research doesn't apply; we care very much about the watershed and the fish habitat, would love to see constructive people get together and find answers so we can have an elevated lake level that still protects the fish.

Skirvin:

Also ask that we put items in the budget to make sure we have money to do some of the things we're discussing, whether it's a pilot study or whatever; none of us wants a green lake, but without appropriations we can't do anything; let's pick 3 or 4 viable ideas, and get vendors involved.

Randy Weldon:

Agreed to look at short-term solutions, but can't overlook long term; excited to hear some possible short-term strategies; we should look harder at several solutions.

Green:

Would like to know which are the most viable solutions?

Skirvin:

Aeration seems cost-effective and we have the money in reserve.

Green:

Alum could be at the top of the list, but the cost is prohibitive.

Skirvin:

Lake Oswego uses pump stations at the tributaries and uses alum on the water before it enters the lake. I don't know that spending \$2 million for two years of success is worthwhile.

Green:

Dredging also prohibitively expensive, and, as Joe Eilers said, it often doesn't work.

Audience comment:

The state won't allow it.

Eilers:

Hydrogen peroxide can be used in predictable systems, but it would have to be used constantly on a lake the size of Devils Lake that is always in flux. It's also very expensive.

Green:

Water column dyes will flow away.

Tina French:

And we'll all look like Smurfs.

Green:

Algaecides would use up the whole budget. Does any algaecide last more than one season?

Eilers:

No.

Green:

Natural hydrology carries no cost, but lots of people don't like the idea. Aeration is within our budget.

Eilers:

One other biological control, but we don't have enough information. A large enough bivalve (a freshwater clam) is hugely effective in filtering nutrients. Maybe there is some way to encourage mussel propagation.

Green:

Favors the start of a monitoring program to get a baseline. While doing that, start moving forward on permits for trial aeration.

Fonseca:

I have never before been required to obtain permit, since the diffusers are not a fixed asset on the lake. It's considered a temporary asset.

Green:

That would be great, but we still have to check. Also need to talk to Pacific Power.

Fonseca:

Offered to spend three days in the field, do 160 core samples, and send to his own lab, and do complete analysis; will indemnify city; will establish baseline study. Will determine sludge depth and content.

Audience question:

Can the diffusers be run off private property, at least for the test study?

Fonseca:

Yes.

Audience question:

Have we ever approached the tribe for funds, since it's an emergency situation, or the city Visitors and Convention Bureau, or economic development funds?

Audience comment:

If a solution provides for a healthy lake, if we're getting satisfactory return, people would be willing to increase the tax revenue.