



# Guidance to Local Health Departments For Blue–Green Algae Blooms in Recreational Freshwaters

*June 2017*



## **BACKGROUND AND PURPOSE**

Blue-green algae, also known as cyanobacteria, occur naturally in lakes and ponds throughout Connecticut. These microscopic organisms are components of the aquatic food chain. In ordinary circumstances, cyanobacteria cause no apparent harm, however warmer water temperatures and high nutrient concentrations may induce a rapid increase in their abundance. This response is commonly called a “bloom” because algal biomass increases to the extent that normally clear water becomes markedly turbid. This tainted water takes on a green, blue-green or reddish-brown colored hue (See Figures 1-3).



Figure 1: Open water view of bloom conditions at Fisher Meadow Pond, Avon CT, in June 2015. View across shoreline and into a cove.



Figure 2: Shoreline view along the Fisher Meadow Pond bloom



Figure 3: View standing at shoreline looking down to water's margin during the Fisher Meadow Pond bloom.

In Connecticut during the summer of 2012, an algae bloom in Lower Bolton Lake raised concerns with the local community and the news media. The response was managed by local health officials with input from stakeholders and State agencies. In anticipation of further algae blooms in subsequent summers, the Connecticut Department of Public Health (CT DPH) and the Connecticut Department of Energy and Environmental Protection (CT DEEP), in collaboration with the Connecticut Association of Directors of Health (CADH), have produced this interim response plan for Connecticut local health officials. This document outlines the rationale for a response and presents a scheme for surveillance and intervention designed to protect the public's health at lakes or ponds used for recreation. The scheme presented is based on precedent from other States. In future years it is likely that this guidance will change subsequent to input from local health officials.

Blue-green algae biomass can contain a mix of toxins, including skin irritants and potent liver toxins. The blue-green algae genera and some of their associated toxins are listed in Table 1. The public health implications of harmful algal blooms (HABs) are indeterminate and continued research on incidence, exposure, and effects is needed. In response, the Center for Disease Control (CDC) conducted a passive surveillance study tracking reports of human and animal morbidity and mortality for the US during the years 2007-2011 (Backer L, 2015). Some results of this study are presented in Table 2. Dermal effects (e.g.; rash, itching, blistering) are the most frequently reported human health effect following direct contact with freshwater blooms. GI/Respiratory effects were also prominent. Where evidence of toxin in lake water was available,

GI/Respiratory effects were attributed to microcystin poisoning; though the acute health effects reported are not symptomatic of microcystin toxicity.

An additional recent study found significant trends in two categories (severe and more severe) of gastrointestinal illness in subjects living near three eutrophic lakes in Quebec. The authors of this study found a dose-dependent association between illness (diarrhea, vomiting, nausea and fever, or abdominal cramps and fever) and lake water endotoxin concentration (Lévesque B, 2015). Some results from this study are shown in Table 3. The authors attribute these effects to either gram negative bacteria or cyanobacteria as each include lipopolysaccharides in cell walls. The Lipid A component of this endotoxin induces fever, diarrhea, and possible fatal endotoxic shock.

**Table 1:** Principal groups of cyanobacterial toxins, their acute toxicities, congeners and known producers. ( Bláha, Babica, & Maršálek, 2009)

Toxins (LD50-acute toxicity-ug/kg ip, mouse)	Structure (number of variants)	Activity	Toxigenic genera
<b>Hepatotoxins</b>			
Microcystins (25 to ~ 1000)	Cyclic heptapeptides (71)	Hepatotoxic, protein phosphatase inhibition, membrane integrity and conductance disruption, tumour promoters	<i>Microcystis</i> , <i>Anabaena</i> , <i>Nostoc</i> , <i>Planktothrix</i> , <i>Anabaenopsis</i> , <i>Hapalosiphon</i>
Nodularins (30 to 50)	Cyclic pentapeptides (9)	Hepatotoxic, protein phosphatase inhibition, membrane integrity and conductance disruption, tumour promoters, carcinogenic	<i>Nodularia</i>
Cylindrospermopsins (200 to 2100)	Guanidine alkaloids (3)	Necrotic injury to liver (also to kidneys, spleen, lungs, intestine), protein synthesis inhibitor, genotoxic	<i>Cylindrospermopsis</i> , <i>Aphanizomenon</i> , <i>Anabaena</i> , <i>Raphidiopsis</i> , <i>Umezakia</i>
<b>Neurotoxins</b>			
Anatoxin-a (250)	Tropane-related alkaloids (5)	Postsynaptic, depolarising neuromuscular blockers	<i>Aphanizomenon</i> , <i>Anabaena</i> , <i>Raphidiopsis</i> , <i>Oscillatoria</i> , <i>Planktothrix</i> , <i>Cylindrospermum</i>
Anatoxin-a(S) (40)	Guanidine methyl phosphate ester (1)	Acetylcholinesterase inhibitor	<i>Anabaena</i>
Saxitoxins (10 to 30)	Carbamate alkaloids (20)	Sodium channel blockers	<i>Aphanizomenon</i> , <i>Anabaena</i> , <i>Planktothrix</i> , <i>Cylindrospermopsis</i> , <i>Lyngbya</i>
<b>Dermatotoxins (irritants) and cytotoxins</b>			
Lyngbyatoxin-a	Alkaloid (1)	Inflammatory agent, protein kinase C activator	<i>Lyngbya</i> , <i>Schizotrix</i> , <i>Oscillatoria</i>
Aplysiatoxin	Alkaloids (2)	Inflammatory agents, protein kinase C activators	<i>Lyngbya</i> , <i>Schizotrix</i> , <i>Oscillatoria</i>
<b>Endotoxins (irritants)</b>			
Lipopolysaccharides	Lipopoly-saccharides	Inflammatory agents, gastrointestinal irritants	All cyanobacteria?

**Table 2:** Cases of human illnesses following exposure to cyanobacteria or algae blooms at freshwater lakes 2007-2011 (Backer L, 2015).

Acute HAB-Related Health Effect	#Cases
Dermal (rash etc.)	89
GI/Respiratory	55

**Table 3:** Multivariate models associating lake endotoxin exposure to gastrointestinal effects in nearby residents (Lévesque B, 2015).

Endotoxin in Lake Water	Health Effect	
	GI1 (moderate)	GI2 (severe)
Contact Tranche	Relative Risk	Relative Risk
T1 (<26 endotoxin/ml)	1.37	1.03
T2 (26-48 endotoxin/ml)	1.35	2.06
T3 (> 48 endotoxin/ml)	2.87	3.11

### **STATUTORY AUTHORITY**

The Connecticut General Statutes outlines enforcement authority under Chapter 98, Municipal Powers. Section 7-148 states that municipalities have the power to “control and operate” recreation places, public beaches and beach facilities. They also have the power to “regulate and prohibit swimming or bathing in the public or exposed places within the municipality”. The CT Public Health Code does not include a pertinent regulation specific for lakes and ponds, however; section 19a-36-B61 may apply to impoundments.

### **SIGNIFICANT EXPOSURE PATHWAYS**

For those recreating on or near an affected water body, the route of direct exposure to toxins from blue-green algae may be via ingestion, breathing, or contact with skin. Ingestion for this recreational scenario is possible when swimming. For example, EPA’s Exposure Factors Handbook (US EPA, 2011) states that boys actively playing ingest 60 ml water in one hour of swimming. It therefore may be necessary to take measures to block the oral and dermal potential exposure pathways by prohibiting swimming during a blue-green algae bloom. As ingestion of relatively large quantities of algae-tainted water can cause serious harm, pet owners should not let their pets swim in an algal bloom. As algae blooms do not occur in groundwater, drinking water wells in the vicinity of the affected lake are not at risk of contamination from potential migration of the algal cells or toxins through groundwater into nearby wells.

Other recreational activities may involve direct exposure and it may be prudent to advise the participating public to avoid direct contact with an algae bloom. These other recreational activities have been compiled and ranked according to relative risk and the published table is reproduced here as Table 4.

**Table 4:** Generalized list of primary exposure pathways of concern for cyanotoxins during recreational activities (Bress & Stone, 2007).

Level of Potential Exposure	Recreational Activity	Primary Exposure Pathway of Concern
High	Swimming/wading	Ingestion
	Diving	Ingestion
	Water skiing/wake boarding	Ingestion/inhalation
	Wind surfing	Ingestion/inhalation
	Jet skiing	Ingestion/inhalation
Moderate	<b>Fish consumption *</b>	Ingestion
	Canoeing	Inhalation/skin
	Rowing	Inhalation/skin
	Sailing	Inhalation/skin
	Kayaking	Inhalation/skin
	Motor boating	Inhalation
Low/none	Catch and Release fishing	Skin

\*Fish living in waters affected by a blue-green algae bloom may accumulate algal toxins in their muscle tissue and internal organs. However the health risk posed by consumption of such fish is uncertain. Toxin levels are usually higher in internal organs than in the muscle tissue. General precautionary advice to anglers to reduce exposure includes:

- Avoid fishing in areas with visible algae blooms due to potential incidental contact with the water.
- Eat fish from water bodies with blue-green algae blooms in moderation (1-2 meals per week.)
- Remove skin and internal organs before cooking. Wash fillets before cooking or freezing

More guidance for safe fish preparation and consumption can be obtained from the State of Oregon's Health Authority ([Link to Oregon's guidance for fishing](#))

The following guidance is organized in two parts. Part one covers surveillance and part two covers interventions for declaring and terminating an algae bloom advisory.

### **PART 1: SURVEILLANCE AND BLUE-GREEN ALGAE BLOOM CATEGORIZATION**

The initial method for surveillance is visual and based on a categorization scheme developed and implemented by the State of Vermont. (Vermont Department of Health, 2008). As is outlined in the Vermont document, the purpose of visual surveillance is to assess bloom development at a beach site. If there is no evidence of a blue-green algae bloom, the site is ranked as Category 1. Observations suggestive or indicative of an algae bloom are classified, respectively, as Category 2 or Category 3. The Vermont guidance is summarized in Table 5. Refer also to the Vermont guidance document for representative photos. ([VT guidance for communities](#))

**Table 5:** Summary of the Vermont visual classification scheme:

<b>Category</b>	<b>Description</b>
One	Visible material is not likely cyanobacteria or water is generally clear.
Two	Cyanobacteria present in low numbers. There are visible small accumulations but water is generally clear.
Three	Cyanobacteria present in high numbers. Scums may or may not be present. Water is discolored throughout. Large areas affected. Color assists to rule out sediment and other algae.

Surveillance is most needed in mid to late summer when algae bloom events are most likely. Reports or complaints from the public or staff require confirmation. Confirmation can be facilitated by consulting someone with prior field experience. Options for consultation include DEEP staff or a professional Limnologist. If such help is not available, health officials in Connecticut should consult the resources available from other State's web sites or the contacts listed in the Additional Resources section of this document. Digital photos of the bloom can provide documentation that could help determine the appropriate course of action.

Laboratory identification and quantification is a reasonable alternative if confirmation cannot be obtained via a visual assessment. If algae bloom species are quantified, then refer to threshold values listed in Table6. A list of available laboratories is included in Appendix A. *Health officials should know that the DPH Laboratory does not offer testing for cyanobacteria or the associated toxins.*

## **PART 2: INTERVENTIONS**

This section outlines intervention strategies for the observational phase and the evaluation phase of a blue-green algae bloom. Interventions are described in Table6. A reasonable protocol may be as follows:

- 1) Visit the site of a reported bloom.
- 2) If justifiable (Category 2), notify State Agencies
- 3) Continue regular field observations. (See example field observation form in Appendix.)
- 4) If conditions deteriorate to Category 3, post the site and the area.
- 5) When visual conditions improve, take a water sample for microscopic analysis.
- 6) Wait approximately one week and sample again.
- 7) A: If justifiable, terminate the posting. (Section B, below.)  
B: Otherwise wait approximately one more week and sample again.
- 8) Repeat step 7 until termination or the end of the summer recreational season.

### **A) Guidance for Declaring an algae bloom Advisory**

CT DPH recommends the following interventions based on results of the surveillance method described above. When issuing an advisory take note of all access points.

Depending on the size of the bloom relative to the lake, and the location of the access point relative to the bloom, some access locations may not be impacted.

#### B) Guidance for Terminating an algae bloom Advisory

Though an algae bloom will wane with time, the health concerns will linger until evidence can confirm that the threat has dissipated. While some States criteria for removing restrictions are based on visual observations over time, most others use a combination of visual observation and environmental laboratory data to validate their visual assessment and to address questions about possible health effects. Laboratory data however has practical limitations due to the logistics of sampling, the extra expense, and long or variable turnaround time. Health officials will thus need to weigh the advantages and disadvantages of collecting environmental laboratory data. Local officials should confer with CT DPH and/or DEEP on the decision to terminate an advisory. The recommended protocol for termination may be based on visual observations over time, or a combination of this taken in concert with laboratory data. The laboratory data approach can be either cell counts or a combination of cell counts and microcystin testing. Yet, as not all blue-green algae blooms produce microcystins, toxin data, alone, is not useful for termination. Obtaining confirmatory biochemical data from a waning blue-green algae bloom may however be justified on grounds that microcystins, can increase as the cells die (Oberholster PJ, 2004). Health officials may thus justify lifting a blue-green algae bloom posting if observations meet either or both of the following two criteria:

- Visual assessment remains at the Category 1 condition for at least two successive and representative observational rounds one week apart
- Cell count results of the water column indicate that blue-green algal cell abundance has markedly decreased over at least two successive and representative sampling rounds one week apart and is below 70,000 cells per ml.

As the situation requires, health officials may consider additional confirmation through microcystin testing of the water column. As is stated for the above, the water column should be below the threshold for at least two successive and representative sampling rounds one week apart. Based on US EPA's draft recreational criterion, CT DPH suggests a toxin threshold of 4 ug/l microcystin (US EPA, 2016).<sup>1</sup> Health officials however should be aware that the authors of this EPA guidance document state that "cyanotoxin production by cyanobacteria is highly variable and strongly influenced by the environmental conditions", and that the propensity for toxin production can differ between strains and clones of the same species, or between and among blooms. This lack of understanding and the potential for a false-negative assessment of putative harm (See research results presented in Tables 2 & 3) highlight the inadequacy of implementing an intervention strategy based solely on microcystin surveillance data to these recreational exposures.

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<sup>1</sup> This document also includes a criterion value for Cylindrospermopsin (8 ug/l). EPA developed these criteria using their standard methodology for risk assessment. Accordingly, the criteria represent a reasonable estimate of a safe exposure. They are thus not thresholds for toxicity. Moreover, as the uncertainty is unknown, the accuracy of these criteria cannot be objectively evaluated.

**Table6:** Suggested interventions based on field observations or cell count data:  
Examples of appropriate signage are shown in Appendix C.

<b><i>Observations</i></b>	<b><i>Notifications</i></b>	<b><i>Further monitoring</i></b>	<b><i>Public Posting</i></b>
Visual Rank Category 1	Not needed	No change	Not needed
Visual Rank Category 2, or blue-green algae cells >20k/ml and < 100k	Notify CT DPH, CT DEEP	Increase regular visual surveillance until conditions change.	Consider cautionary postings at public access points. (See Appendix C, Example B)
Visual Rank Category 3, or blue-green algae cells > 100k/ml	Update/inform CT DPH & CT DEEP and expand risk communication efforts. (See Risk Communication section.)	Collect samples for analysis and/or increase frequency of visual assessment.	POSTED BEACH CLOSURE: If public has beach access, alert water users that a blue-green algae bloom is present. (See Appendix C, Example A) POSTED ADVISORY: At other impacted access points. (See Appendix C, Example C)

### **RISK COMMUNICATION**

Effective public notification and risk communication are important attributes during and immediately after a blue-green algae bloom. Posting closure signs at swimming areas and advisory signs at other access points used for public recreation is the primary intervention. The examples of signage presented in Appendix C may serve as a model for this. Signage shown in Appendix C, Example A is for posting at municipal beaches, while example B is for posting at public access points during category 2 conditions. Example C is for posting at non-beach public access points (e.g.; boat launches). If signs are posted at a public access point then they should be removed no later than the end of October. Further interventions include notifying lake associations and posting information for public access via the internet or local newspapers via a press release. Include information as to how the public can contact the CT DEEP for the most up-to-date information on the status of the blue-green algae bloom. In some communities it may also be important to notify local Veterinarians and Physicians and keep them updated on the status of the blue-green algae bloom.

### **SUMMARY**

Blue-green algal blooms can be unsafe and local health officials can mitigate the hazard by the surveillance and intervention approaches outlined above. The approaches do not include treatment, but involve implementing strategies that will decrease the extent of the public's exposure.

The approaches recommended in this guidance for monitoring and characterization of blue-green algae bloom events includes visual observation (as is used in Vermont) in conjunction with a measure of blue-green algal cell abundance. If an algal bloom event is evident, then municipalities have the authority to close an impacted beach and/or issue a warning at other access points where recreational activities may involve contact with tainted water.

Blue-green algae blooms wane over time and there is thus the need to ascertain the point in time where an advisory should be removed (i.e.; terminated). The recommendations for termination of an advisory or closure are either based on visual observations over time, or a combination of visual and laboratory data. There are advantages and disadvantages to using environmental data, and the local health official will need to decide which strategy is most appropriate for the situation.

## **REFERENCES**

- Bláha, L., Babica, P., & Maršálek, B. (2009). Toxins produced in cyanobacterial water blooms – toxicity and risks. *Interdiscip Toxicol.*, 36–41.
- Backer L, e. a. (2015). Cyanobacteria and Algae Blooms: Review of Health and Environmental Data from the Harmful Algal Bloom-Related Illness Surveillance System (HABISS), 2007-20011. *Toxins*, 1048-1064.
- Bress, D., & Stone, W. (2007). Addressing Public Health Risks for Cyanobacteria in Recreational Freshwaters: The Oregon and Vermont Framework. *Integrated Enviornmental Assessment and Management*, 3(1), 137-143.
- Lévesque B, e. a. (2015). Exposure to cyanobacteria:acute health effects associated with endotoxins. *Public Health*, <http://dx.doi.org/10.2016/j.puhe.2015.11027>.
- Oberholster PJ, B. A. (2004). Microcystis aeruginosa: source of toxic microcystins in drinking water. *African Journal of Biotechnology Vol. 3 (3)*, 159-168.
- US EPA. (2011). *Exposure Factors Handbook*.
- US EPA. (2016). *Human Health Recreational Ambient Water Quality Criteria or Swimming Advisories for Microcystins and Cylindrospermopsin- DRAFT*. EPA 822-P-16-002.
- Vermont Department of Health. (2008). *Cyanobacteria (Blue-green Algae) Guidance for Vermont Communities*. [http://healthvermont.gov/enviro/bg\\_algae/documents/BGA\\_guide.pdf](http://healthvermont.gov/enviro/bg_algae/documents/BGA_guide.pdf).
- World Health Organization. (1999). *Toxic Cyanobacteria in Water: A guide to their public health consequences, monitoring and management*. Geneva: E & FN Spon.

## **ADDITIONAL RESOURCES**

### **For health questions - contact**

CTDPH

Stewart Chute, Toxicologist

860-509-7758

Stewart.chute@ct.gov

### **To report a blue-green algae bloom – contact**

CT DEEP

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Tracy Lizotte, Environmental Analyst

860-424-3031

deep.algalblooms@ct.gov

## **INTERNET LINKS**

[CDC fact sheet on algal blooms for veterinarians](#)

[VT guidance for communities](#)

[EPA Cyanobacterial Harmful Algal Blooms \(CyanoHABs\)](#)

[Massachusetts DPH Protect Your Pets From HABs](#)

[Maine DEP Web page](#)

[New Hampshire DES webpage](#)

[New York State DOH Information Bulletin](#)

[Ohio DH Fact Sheet](#)

[Oregon DEQ: Water Quality - Harmful Algal Bloom Strategy](#)

[EPA's Cyanobacteria Monitoring Collaborative](#)

## **APPENDIX A:**

## **LABORATORIES FOR BLUE-GREEN ALGAE TESTING (NEIWPCC-2015)**

### **Academy of Natural Sciences – Phycology Section**

Patrick Center for Environmental Research

1900 Benjamin Franklin Parkway

Philadelphia, PA 19103

Tel: (215) 299-1080

Fax: (215) 299-1079

Email General: [patrickcenter@ansp.org](mailto:patrickcenter@ansp.org)

Email Don Charles: [dfc63@drexel.edu](mailto:dfc63@drexel.edu)

Email Frank Acker (primary soft-algae taxonomist): [fwa23@drexel.edu](mailto:fwa23@drexel.edu)

Services: Identification of algae and algal measurements/biovolume, cell counts, chlorophyll

Pricing: (Can give estimate based on sample, and separate the phytoplankton and periphyton in terms of how they are processed)

- Semiquantitative count (relative abundance, five-point scale, rare to abundant) – \$150-200
- Algal identification (cell count, biovolume) – \$440-550
- Chlorophyll (fluorometer) – Call for cost
- Diatom count – \$300

### **Aquatic Services, Wayne Carmichael, Ph.D.**

42184 Tweedle Lane

Seaside, Oregon 97138

Tel: (503) 755-0711

Email: [wayne.carmichael@wright.edu](mailto:wayne.carmichael@wright.edu)

Services: Retired, limits active lab work to Algal Identification/Enumeration.

Pricing:

- Algal Identification (genus/species when possible) – \$100
- Enumeration/biovolume – \$150

### **Beagle Bioproducts, Inc., (<http://beaglebioproducts.com/>)**

959 Schrock Rd

Columbus, OH 43229

Tel: 614-519-0154

Email Stephanie: [stephanie.smith@beaglebioproducts.com](mailto:stephanie.smith@beaglebioproducts.com)

Services: Toxin testing (ELISA for service- based testing, can also do LC/MS for contracts), algal ID (generally not enumeration, but can do that for contracts).

Pricing:

- Microcystin, cylindrospermopsin, anatoxin, or saxitoxin ELISA – \$125
- Algae identification (non-quantitative scan for presence/absence) – \$75

*Note: may also offer a heavily discounted regular testing program for drinking water facilities in 2016.*

**CyanoPros, ([www.cyanopros.com](http://www.cyanopros.com))**

Alan Wilson - Assistant Professor  
Auburn University - Fisheries and Allied Aquacultures  
203 Swingle Hall  
Auburn, Alabama 36849  
Tel: 703-292-5190

Email General: [cyanopros@auburn.edu](mailto:cyanopros@auburn.edu), [alan.e.wilson@gmail.com](mailto:alan.e.wilson@gmail.com)

Services: Phytoplankton enumeration (abundance or biovolume), identifications, toxin testing (ELISA only, for microcystin, cylindrospermopsin, saxitoxin), and other water quality analyses.

Pricing:

- Microcystin ELISA in algae – \$50
- Microcystin ELISA in water – \$50
- Microcystin ELISA in fish – \$125
- Cylindrospermopsin ELISA – \$100
- Saxitoxin ELISA – \$50
- Phytoplankton identification – \$50
- Phytoplankton culturing – \$100
- Phytoplankton enumeration – contact them
- Chlorophyll a – \$25

**EcoAnalysts, Inc.**, ([www.ecoanalysts.com](http://www.ecoanalysts.com))

Main Office

1420 South Blaine St., Suite 14, Moscow, ID 83843

Tel: (208) 882-2588

Fax: (208) 883-4288

Email General: [eco@ecoanalysts.com](mailto:eco@ecoanalysts.com)

Email Gary: [glester@ecoanalysts.com](mailto:glester@ecoanalysts.com)

Services: phytoplankton counts, biovolume, and identification (including cyanobacteria), toxin analysis

Pricing:

- ELISA (Microcystin, Saxitoxin, Anatoxin A, Cylindrospermopsin) – \$115-200, per analysis, depending on the number of samples in the batch
- Taxonomic analysis of cyanobacteria (taxa present, cell counts, cell densities, but no photographs or measurements/biovolume) – \$90 per sample
- Taxonomic analysis of cyanobacteria (taxa present, cell counts, cell densities, and also biovolume measurements) – \$135 per sample
  - Digital Images: \$25 per taxon
- Full community taxonomic analysis (no biovolume) – \$165-195
- Full community taxonomic analysis (with biovolume) – \$250-290

*Note: Three full-time algae taxonomists on staff, can turn samples fairly quickly depending on the number received per batch.*

**GreenWater Laboratories/CyanoLab**, ([www.greenwaterlab.com](http://www.greenwaterlab.com)), Andrew Chapman or Mark Aubel

205 Zeagler Drive, Suite 302

Palatka, FL 32177

Tel: (386) 328-0882 or (877) 869-2542

Fax: (386) 328-9646

Email General: [info@greenwaterlab.com](mailto:info@greenwaterlab.com)

Email Mark Aubel: [achapman@greenwaterlab.com](mailto:achapman@greenwaterlab.com)

Email Andrew Chapman: [andrewchapman@greenwaterlab.com](mailto:andrewchapman@greenwaterlab.com)

Services: Algal Identification/Enumeration, Toxin Testing.

Pricing:

- Phycological Services
  - Potentially Toxic Cyanobacteria Screen – \$75
  - Qualitative Algal Identification – \$100
  - Cyanobacteria ID & Enumeration – \$150
  - Total Algal ID & Enumeration – \$200
  - Algal ID, Enumeration & Biovolume – \$325
- Microcystins/Nodularin:
  - ELISA – \$100-125
  - LC-MS & UV Scan – \$250-275
  - LC-MS/MS Suite (12 Variants & Nodularin) – \$250-275
  - LC-MS/MS MMPB (oxidation, extraction & analysis for water) – \$200-250
- Cylindrospermopsin
  - ELISA – \$125-150
  - LC-MS/MS – \$150-200
- Anatoxin-a
  - LC-MS/MS – \$200-250
- Saxitoxins
  - ELISA – \$125-150
  - LC-MS/MS Suite (C1/C2, GTX (1,2,3,4,5), dcGTX2/3, dcSTX, NEO, STX) – \$250-300
- BMAA (includes isomers AEG & DAB) LC-MS/MS – \$250-300
- 4 toxin bundle: Microcystins (ELISA), Cylindrospermopsin (LC-MS/MS), Saxitoxin (ELISA), Anatoxin-a (LC-MS/MS) – \$500

**Northeast Laboratories, Inc. ([www.nelabsct.com](http://www.nelabsct.com))**

129 Mill Street

Berlin, CT 06037

Tel: (860) 828-9787 (Ext. 103 for Alan Johnson) or Toll free in state: (800) 826-0105 and out of state: (800) 654-1230

Fax: (860)829-1050

Email General: [nelabsct@aol.com](mailto:nelabsct@aol.com)

Email Alan Johnson: [alan@nelabsct.com](mailto:alan@nelabsct.com)

Services: Algae/Cyanobacteria Cell Counts & Identification (to genus, not to species), cyanotoxins (Microcystins, Nodularin, Cylindrospermopsin – ELISA, and Abraxis screening dip sticks, potentially also looking at LC-MS for Microcystins)

Pricing: Depends significantly on turnaround time (if things need to be rushed).

- Cell Counts (including identification) – \$45-80
- Semi-quantitative screening (Abraxis) – \$50
- ELISA – \$75-80
- Chlorophyll a – \$60

**PhycoTech, Inc., (<http://www.phycotech.com>)**

620 Broad Street, Suite 100

St. Joseph, MI 49085

Tel: (269) 983-3654

Fax: (866)728-5579/(269)983-3653

Email General: [info@phycotech.com](mailto:info@phycotech.com)

Services: Phytoplankton counts (to species, Natural Units/mL and Cells/mL) including toxin and taste/odor cyanobacteria, with full archival slides if requested. Will have a fast response semi-automated solution available starting June 1, 2016.

Pricing:

- Phytoplankton Analyses
  - Species count w/ biovolume calculations – \$359
  - Species count w/o biovolume calculations – \$260
  - Genus count w/ biovolume calculations – \$239
  - Genus count w/o biovolume calculations – \$170
  - Division count – \$163
  - Relative count to species – \$260
  - Relative count to genus – \$170
- Phytoplankton Analysis Targeted for Algal Blooms
  - Rapid Assay: Qualitative Species (when possible) Assay weighted for Biovolume, with 3 HPMA slides – \$183
  - Rapid Assay: Qualitative Species (when possible) Assay weighted for Biovolume, without HPMA slides – \$122
  - Toxic/Bloom Scan, One Species – \$130
- Chlorophyll-A – \$99

**SUNY-ESF, Dr. Greg Boyer, Professor of Biochemistry**

Syracuse, NY 13210

Tel: (315) 470-6825

Email Greg Boyer: [glboyer@esf.edu](mailto:glboyer@esf.edu)

Services: Capable of analyzing for many cyanobacteria toxins: Microcystins and nodularins -80 congeners; Paralytic shellfish toxins 56 congeners; anatoxin-a (6 congeners), anatoxin a(S) 1 variant and cylindrospermopsin (3 congeners). Can also analyze chlorophyll, phycocyanin, and can identify species/genus for samples. Results from analyses are generally available within three to four weeks by telephone or email.

Pricing: Rush orders (within 10 days) include a surcharge of \$50-200 per sample, and advance arrangements must be made.

- Basic handling charge (includes data processing, sample filtration and preparation of extract, reports, voucher sample storage for 1 year and all our labor) – \$110
- Microcystin analysis by PPIA (activity based enzyme assay) – \$40
- Microcystin analysis by ELISA (antibody based structure assay) – \$90
- Microcystin analysis by LCMS (HPLC with UV and mass selective detection) – \$40
- Microcystin analysis by LC-MS/MS (HPLC analysis with tandem MS detection) – \$90
- Tissue microcystins by MMPB (Bound microcystins in tissue by oxidation Anatoxin-a by HPLC-LCMS \$25 (HPLC with mass selective detection) – \$call
- Anatoxin-a by HPLC-FD (James et al HPLC via fluorescence detection) – \$call
- Cylindrospermopsin by HPLC-PDA-MS (HPLC assay w/ uv and MS detection) – \$25
- Cylindrospermopsin by ELISA (antibody based structure assay) – \$90
- Beta methyl amino alanine by LC-MS (HPLC with mass selective detection) – \$50
  - Bound BMAA as above (Determination of protein bound BMAA) – \$90
- Anatoxin-a(s) by ACEI (activity based enzyme inhibition assay) – \$call

*Note: Greg cautioned that the lab is often manpower short – just because something is on the price sheet does not mean that the lab is actively running any given assay at any given time.*

### **UConn Center for Environmental Science and Engineering**

([http://www.cese.uconn.edu/analyt\\_serv.html](http://www.cese.uconn.edu/analyt_serv.html))

3107 Horsebarn Hill Road; U-4210

Storrs, CT 06269

Phone: (860) 486-2668

Email: [christopher.perkins@uconn.edu](mailto:christopher.perkins@uconn.edu)

Services: Toxin analysis (ELISA and UPL/MS/MS)

Pricing:

- UPLC/MS/MS for microcystins (-RR, -YR, -LR, and -LA) and anatoxin-a in water – \$139 for CT state agencies and municipalities, otherwise \$182
  - Analysis for these compounds in filters – \$151 for CT state agencies and municipalities, otherwise \$199
- Total microcystin in water – \$81 for CT state agencies and municipalities, otherwise \$107

**Water Resource Services Inc.**, Dr. Kenneth J. Wagner, Ph.D., CLM

144 Crane Hill Road

Wilbraham, MA 01095

Tel: (413) 219-8071

Email: [kjwagner@charter.net](mailto:kjwagner@charter.net)

Services: Identification and count to genus level, many other lake management services.

Pricing: Unknown.

*Note: Ken has a limit on how many clients he can serve, as this is only one of many lake management services he offers. He recommends Greenwater Labs for one shot assessments, and if ongoing testing is needed, he suggests contacting Abraxis about getting kits to do one's own analyses.*

## **APPENDIX B:**

### **Section A: Connecticut DEEP Proposed Cyanobacteria Sampling Methodology**

Monitoring for blue-green algae should be directed at areas of highest concentrations and risk to public health. These areas are typically along the shoreline of lakes and ponds and often can include bathing beaches that are already the responsibility of State, local and other responsible entities. Contact DEEP for advice if samples are to be obtained from deep water.

A description of the proposed shoreline sampling approach is outlined below. The detailed sampling protocol should be obtained from the chosen analytical laboratory.

#### **Sampling at the Shoreline**

- Sampler should be using waders and long sleeved rubber gloves
- Clearly mark sampling containers with required information (site #, date, time, etc.)
- Wade to an approximate depth of three feet
- Invert sample bottle(s) to collect a sample at approximately 18 inches below the surface
- Decant water for required air space and/or pour into additional containers (if necessary), cap bottles
- Visual observations – look to see if bottom is visible, if a scum on water's surface is present
- Fill out chain of custody, including visual observations
- Store samples in a cooler with ice until delivery to lab(s)

#### **Sampling the Shoreline from a Dock, Wall, or Boat**

- Sampler should be using long sleeved rubber gloves
- Clearly mark sampling containers with required information (site #, date, time, etc.)
- Choose a location that is approximately three feet deep (if possible)
- Lean over to collect sample (if possible), or use a pole sampling device to collect sample
- Invert sample bottle(s) to collect a sample at approximately 18 inches below the surface
- Decant water for required air space and/or pour into additional containers (if necessary), cap bottles
- Visual observations – look to see if bottom is visible, if a scum on water's surface is present
- Use a Secchi disk with calibrated line to determine transparency and total depth
- Fill out chain of custody, including visual observations
- Store samples in a cooler with ice until delivery to lab(s)

### Logistical Issues

1. Long holding times may result in higher counts.
2. Shoreline concentrations tend to be highest in the afternoon.
3. Blue-green algae blooms may be highly localized and vary in location in a lake. One shoreline may be experiencing a bloom while another shoreline can be clear of a bloom.
4. Blue-green algae cells and toxins concentrations can differ considerably on a daily basis. Repeat sampling may be necessary.
5. Blue-green algae cells can be high and toxin levels can be low from the same sample.
6. Blue-green algae cells can be low and toxin levels can be high from the same sample.

## **Section B: Example Field Observation Sheet**

Date of Observation: \_\_\_\_\_

Time: \_\_\_\_\_

Name of

Waterbody: \_\_\_\_\_ Town: \_\_\_\_\_

Description of

Location: \_\_\_\_\_

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*Take and Send Digital Photos to DPH/DEEP*

### **Visual Assessment:**

Water Clarity (check all that apply):

- ☐ Clear
- ☐ Cloudy
- ☐ Hazy

Water Color (check all that apply):

- ☐ Green
- ☐ Brown
- ☐ Milky white
- ☐ Blue-green
- ☐ Red
- ☐ Clear

Visible Bloom (circle one): ☐ Yes ☐ No ☐ Don't know

Visible Scum (circle one): ☐ Yes ☐ No ☐ Don't know

### **Observations:**

Are there people swimming? ☐ Yes ☐ No ☐ Don't know

Are there people boating and jet skiing? ☐ Yes ☐ No ☐ Don't know

Are there people with dog recreating in the area? ☐ Yes ☐ No ☐ Don't know

Reporters Name: \_\_\_\_\_

Phone Number: \_\_\_\_\_

**Section C: Postings for beaches and other public access points .**

*Example A: Posing for a Municipal Beach Closure*

# ATTENTION

## SWIMMING AREA CLOSED



As of \_\_\_\_\_ the local health officer has  
determined that swimming in the area presents a  
public health risk from an algae bloom.

***For more information contact:***

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Keeping Connecticut Healthy

**DPH**

Connecticut Department  
of Public Health

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Example B: Cautionary (Category 2) Posting



# NOTICE



*An increased risk of an algae bloom has made this area potentially unsafe for water contact*

**Be alert and avoid skin contact with water that:**

- Looks like spilled paint
- Has surface scums, mats or films
- Is discolored or has colored streaks
- Has green globs floating below the surface

*Keep children and pets away from algae blooms and rinse off any exposed skin or fur with clean water.*

**For more information contact:**

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Posting produced in collaboration with  
**CT DEEP and CT DPH**

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VOTV

VOTV TEAM, LLC MANASSAS, VA 22106-0001 www.votvteam.com 1-800-471-0609

Example C: "Advisory" Posting for non-Beach Public Access Point

