

LakeForecast Water Quality Monitoring



**Nearshore Monitoring Manual
for the Yahara Watershed**

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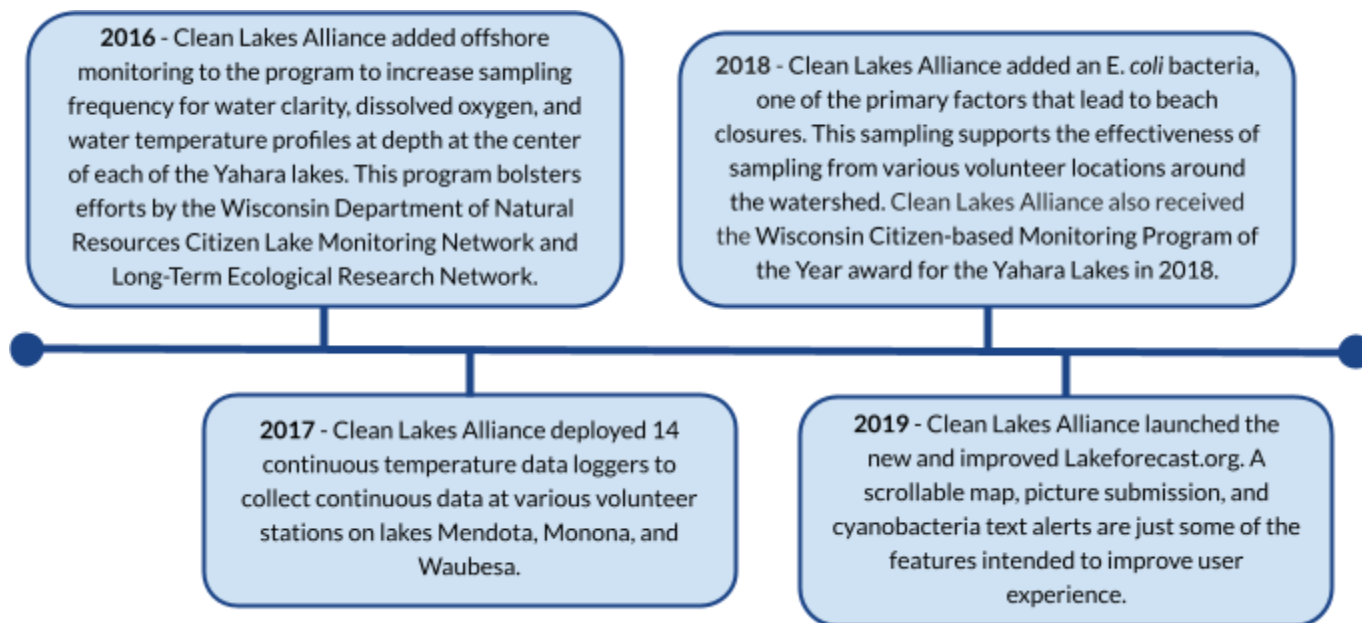
Background

a. The Program

In 2013, Clean Lakes Alliance launched the Yahara Lakes Monitoring program in response to findings from a 2011 study by Richard Lathrop and Steve Carpenter. The study identified the importance of monitoring nearshore water quality conditions to safeguard public safety. Partnering with Wisconsin Department of Natural Resources, Public Health Madison & Dane County, UW- Madison Center for Limnology, Long Term Ecological Research, 5Nines, Madison College, City of Madison lifeguards, UW Space Science and Engineering Center, and UW Morgridge Center for Public Service, Clean Lakes Alliance is entering the eleventh year of implementation.

Clean Lakes Alliance recruits the support of Greater Madison citizens to measure and record various water quality parameters, including clarity, temperature, and various visual observations in the nearshore environment. These volunteers ranging from UW- Madison students to retired community members graciously donate their time on a weekly (and in some cases daily) basis during the summer season. This program wouldn't be possible without the dedication of the volunteers.

b. Progress Highlights



Since its inception, the program has expanded to include around 90 nearshore sites and 7 offshore sites and collected over 12,800 condition reports.

c. The Yahara River Watershed



- Watershed size: Approximately 540 square miles
- Total lakes surfaces: 29 square miles
- Total lakes shorelines: 66 miles
- Across 3 counties: Columbia, Dane, and Rock (with 87% of area in Dane)
- Drains to 5 lakes: Mendota, Monona, Wingra (not part of chain), Waubesa, and Kegonsa (Figure 1)
- The watershed begins in the headwaters of the Yahara River in Columbia County and end at the confluence with the Rock River
- All of the five Yahara lakes are lowland drainage lakes
- Water quality in drainage lakes can be highly variable because they are fed by streams, groundwater, precipitation, and runoff

The Purpose of the Nearshore Monitoring

The monitoring of nearshore water quality conditions serves many purposes:

1. It provides information to the **LakeForecast.org website** that combines your condition reports with other water quality information, such as beach closures, to the general public in real time. This website **helps Yahara lake users choose where they'd like to spend time on the lakes.**
2. It **helps researchers** understand the conditions that create damaging algal blooms because it supplements the sampling conducted by other entities, creating a **more robust dataset** for all parties to draw upon.
3. It tracks changing beach conditions and the formation and movement of **potentially toxic cyanobacteria and algal blooms**. Knowing where algal blooms are occurring helps inform and **protect the public.**
4. It **builds awareness and educates the public** about lake ecosystems and water quality.
5. It keeps Clean Lakes Alliance staff informed about rapidly changing lake conditions, so we can then better communicate the state of our lakes to lake managers and other stakeholders. You are the watchful eyes on our lakes.



LakeForecast Program Goals

The project goals are to:

- Maintain approximately 100 volunteers to provide adequate nearshore spatial coverage around the Yahara lakes
- Maintain increased frequency of monitoring at all public beaches by allowing multiple monitors to participate at the same location
- Conduct in-person and virtual training for all new volunteers
- Emphasize accurate data entry, correct identification of cyanobacteria, and proper transparency tube protocols
- Incorporate baseline aquatic invasive species education and raise awareness of emerging threats. All volunteers should know what to do if they suspect the presence of a new invasive
- Perform offshore monitoring of water clarity, temperature, and dissolved oxygen at the deep hole on all five Yahara lakes
- Increase the number of *Lake Forecasting Stewards*
- Maintain partnership with PHMDC - advocate for more robust testing and appropriate educational signage at public beaches
- Upon evaluation of costs, collaborate with Design Garden to identify LakeForecast user experience and data visualization improvements
- Maintain partnerships with UW-Madison Civil & Environmental Engineering (microcystin testing) and BloomOptix (HabAlert evaluation tool)
- Host meetings with researchers at UW to cultivate partnerships and explore opportunities to use the extensive LakeForecast data set
- Provide at least one in-person volunteer engagement opportunity to thank and recognize the value of our volunteers
- Award all volunteers who have reached 5 years of commitment to the program



Getting Started

If you are a first-time volunteer, training will be provided. Additional training or a refresher are not required but can be requested. Volunteers should reference [the training video on Clean Lakes Alliance's Water Quality Monitoring webpage](#) or on [YouTube](#) for a refresher on the protocols used during the sampling period.

Throughout the year, **Caitlin McAleavey** will provide assistance and support to volunteers. This support includes obtaining and disseminating equipment and supplies (e.g. monitoring equipment and manual), troubleshooting equipment issues, and performing periodic check-ins to answer questions.

Volunteer Timeline and Sampling Schedule

a. Sampling Schedule

Sampling should be completed **twice a week at a minimum**, but more sampling per week is always encouraged. Volunteers are expected to complete the minimum sample collections per week when possible. If volunteers become unable to collect, we ask that the volunteer (or someone on behalf of the volunteer) reach out to Caitlin McAleavey at caitlin@cleanlakesalliance.org. **Clean Lakes Alliance recommends sampling in the morning between 7 AM and 12 PM.**

Example Schedule

- Tuesday/Thursday morning between 7AM and 12PM
- Thursday/Saturday morning between 7AM and 12PM
- Saturday/Tuesday morning between 7AM and 12PM

We are asking all volunteers to sample two times per week or more to help increase the timeliness of information to lake users through LakeForecast.org and the Weekend Lake Report on social media. LakeForecast.org, displaying the observations with an exclamation point as shown in the picture.



b. Volunteer Timeline

Event	Calendar Date	Note
Start of 2023 monitoring season	May 29th	Volunteers are welcome to start earlier than May 29th, if interested
End of 2023 monitoring season	September 4th	Volunteers can sample through the end of September, if interested

Types of Data Collection

a. Quantitative vs. Qualitative Collection

Data can be collected in two ways: quantitative and qualitative. Quantitative data refers to the number of variables, and qualitative data refers to visual variables.

Quantitative parameters to be measured include:

- Water temperature and air temperature measured using a digital thermometer
- Water turbidity (an indicator of clarity) will be measured using a 120cm turbidity tube

Qualitative, visual observations will be collected for:

- Wave intensity
- Waterfowl presence
- Surface bloom presence
- Algal bloom type: monitors are trained to distinguish and report green algae and cyanobacteria algae bloom at their sites (Appendix 5)
- Floating plant debris abundance
- Bather load (or the number of people in the water)
- Visual water clarity

b. What is my Sample Area?

When collecting data, volunteers should make observations within a set **sample area**. Monitors should visualize an area approximately 50 feet in all directions from the sample location where water temperature and turbidity were measured. This means not looking far out into the lake to record your qualitative observations, and only observing conditions near shore.

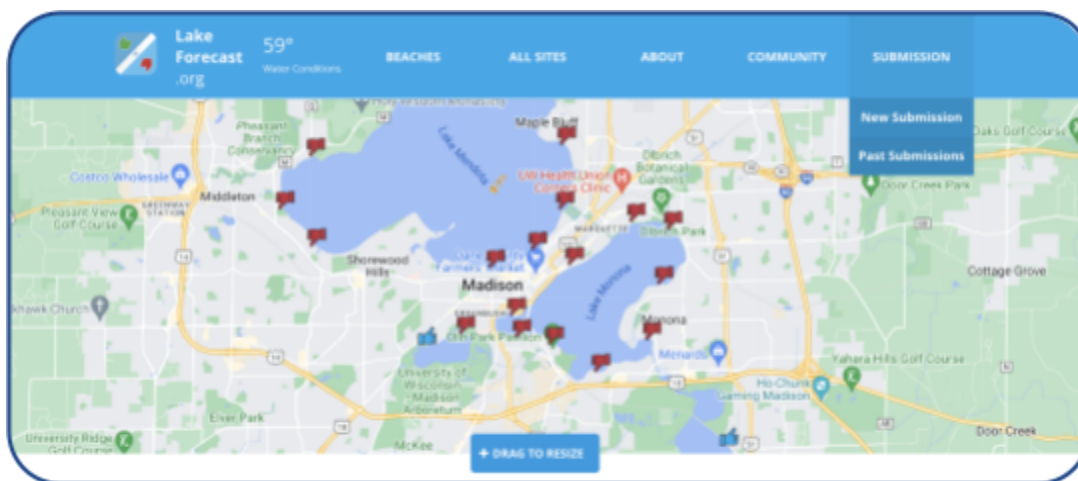
General Rules of Sampling

General Rules

1. Sample air temperature as close to the lake sample collection site as possible
2. Allow the temperature probe to stabilize before recording the value
3. Use your body to “shade” the turbidity tube
4. Pressing the “hold” button freezes the current temperature on the screen for easier recording
 - i. Thermoworks thermometers do not have a “hold” button
5. Remember to remove the plastic sheath that covers the temperature probe when sampling.
6. You can switch between °C and °F by pressing the [°C/°F] button.
 - i. This button is located on the back of Thermoworks thermometers

Step 1 - Data Submission

As you collect your data, it is recommended to have the LakeForecast website open, and the submission form readily available.



The **Monitor Login** button at the bottom of the page will direct you to **enter your username and password**. Once logged in, select the **New Entry** button at the top right and follow the prompts to enter your visual and quantitative observations. Please submit your data as soon as you have finished collecting it to ensure accuracy for those viewing the data online. While some volunteers like to collect data and submit it at a later date as a batch, we ask that you do not do that to ensure that all data remains up to date.

Equipment Checklist:

- Device to enter data onto LakeForecast website
- 120 cm Turbidity Tube (Provided by Clean Lakes Alliance)
- Thermometer (either Thermoworks or Fisher Scientific brand provided by Clean Lakes Alliance)



✓ Device


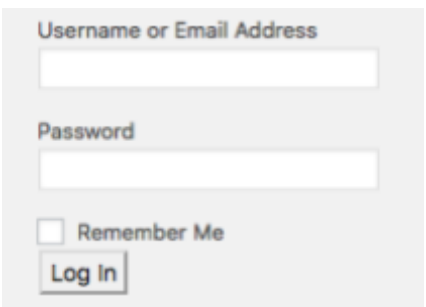


✓ Turbidity Tube



✓ Thermometer

Step 2 - How to Submit Data on LakeForecast.org

<p>Step 1 - Go to https://lakeforecast.org/#/ and scroll to the bottom of the page, then click "Monitor Log In" OR "Submit Collection" if already logged in</p>	
<p>Step 2 - Enter your username and password then click "Log In"</p>	

Step 3 - Enter date and time. Your site ID code will automatically update

Site Collection

A collection of data for a waterfront sampling site.

Select Site *

MendotaBeach28

Sample Time *

1 : 44 PM

HH

MM

Sample Date *

01/13/2023

Upload an image

Choose File No file chosen

Step 4 - Select the appropriate visual observations

Visual Observations

Wave Intensity (click one)



Calm to small ripples



Small to moderate chop



Rough water

Waterfowl (click one)



None



Some (1-10)



A lot (greater than 10)

Step 6 - Enter Qualitative Measurements and comments, then click "Submit"

Quantitative Measurements

Air Temp (F)

e.g. 68.0

Water Temp (F)

e.g. 68.0

Water Clarity (cm)

e.g. 33.0

Step 3 - Qualitative Data Collection Instructions

Step 1 - Collect Observations

1. Open your smartphone/tablet and navigate to LakeForecast.org
2. Click the **Monitor Log In** button to access your submission page

Step 2 - Enter Data

1. Please enter the data into the online submission form on Lakeforecast.org using your username and password provided by Clean Lakes Alliance.

Metric	Measurement of Metric
Rate wave intensity on a scale of 1-3	1 = Calm to small ripples 2 = Small to moderate chop 3 = Rough water
Presence of waterfowl, in the water or at the lake edge, paying particular attention to geese/ducks	1 = None 2 = Some (between 1 and 10 waterfowl present) 3 = A lot (greater than 10 waterfowl present)
Presence of surface algal blooms within the general vicinity of the sampling area	1 = None 2 = Some presence 3 = Strong presence
Algal bloom type	G = Green algae CY = Cyanobacteria BOTH = Both green algae and cyanobacteria are present
Abundance of floating uprooted plant debris	1 = None 2 = Small coverage 3 = Heavy coverage
Number of people in the water	1 = None 2 = Some (between 1 - 10 people in the water) 3 = A lot/crowded (greater than 10 people in the water)
Water clarity	Good = Can see toes Fair = Can barely see toes Murky = Cannot see toes

Step 4 - How to Collect Field Samples

Step 1 – Perform an Air Temperature Measurement

Best practice is to perform air temperature measurements before water temperature

1. Turn on the thermometer by pressing the [ON/OFF] button
2. Remove the temperature probe from the probe chamber. Allow time for the thermometer to stabilize. This can take up to one minute.
3. Hold the thermometer so that it is shaded by your body
4. Allow the temperature to stabilize (this can take up to one minute)
5. Record stabilized temperature in °F on the water quality monitoring data sheet

Step 2 – Perform a Water Temperature Measurement

1. Turn on the thermometer by pressing the [ON/OFF] button
2. Sample the surface at a location where it is ~3 feet total depth
3. Carefully move to the sampling location, while wading slowly in the water. If collecting samples from your pier, sample as above (3 feet total depth) but disregard the wading.
4. Remove the temperature probe from the probe chamber
5. Insert the thermometer vertically into the water, submerging the silver probe
6. Allow the temperature to stabilize
7. Record stabilized temperature in °F on the datasheet

Step 3 – Enter Data into LakeForecast.com

1. Please enter the data into the online submission form on Lakeforecast.org using your username and password provided by Clean Lakes Alliance

How to Change the Thermometer Battery

- You may need to replace the battery periodically during the sampling season.
- To replace the battery, remove the screw cover with a small Phillips screwdriver, carefully remove the old battery and replace it with a new battery in the same position as the old battery, and re-screw the cover back on the thermometer.
- LR44 batteries are used in the Thermoworks thermometers and CR2032 batteries are used in the Fisher Scientific thermometers. Batteries can be obtained from a hardware store.

a. Turbidity Measurement Instructions

Step 1 – Equipment Checklist

- 120cm turbidity tube
- Device to enter data onto the LakeForecast website

Step 2 - Collect the Sample

1. Sample at 3 feet total depth
2. Dip the tube 6 inches into the water at your sampling site and fill it to the top

Step 3 – Turbidity Measurement

1. Take your filled turbidity tube to a shaded spot. If there is no shade around, use your body to block the sun from shining on the tube
2. Look down through the tube toward the target disk on the bottom of the tube.
3. If the disk is visible, record the water level as 120 centimeters
4. If the disk is not visible, slowly release water from the release valve until the disk at the bottom of the tube becomes visible. Record the water level in centimeters (cm).
5. Submit all data to the LakeForecast app

b. How to Perform Turbidity Measurements

What is Turbidity?

Turbidity is a measurement of how cloudy water appears. Turbidity is also a measure of how much light passes through water and is caused by suspended solid particles that scatter light.

What creates Turbidity?

Microscopic particles made up of plankton, stirred-up sediment or organic materials, eroded soil, clay, silt, sand, mud, industrial waste, chemical precipitates, or urban runoff.

General Rules and Tips for Turbidity Sampling

- Do not wear sunglasses when sampling
- Record the value when you can first see the white and black disk: the moment you first recognize the contrasting pattern, not necessarily when the pattern is completely visible.
- Keep the tube vertical when taking your reading. It is easy to accidentally tilt the tube as you lean over to view the Secchi disk.



Cleaning the Turbidity Tube

Although Clean Lakes Alliance cleans the tubes between seasons, you may want to periodically clean your tube if it starts collecting algae or other debris that obstructs the view of the black and white Secchi disk.

- To clean your tube, it is best to use a long-handled brush that can be pushed to the bottom of the tube. An attached string or broom handle is necessary for easy removal. A small amount of environmentally friendly cleaner can help remove dirt and algae. Rinse well with a garden hose or your indoor sink.

Additional Data to Collect

a. Microcystins Strip Test

In 2022, Clean Lakes Alliance worked with UW Water Systems & Society Research Group to conduct Microcystins testing. Microcystins are a class of toxins produced by cyanobacteria. The data collected will be used to estimate the number of Microcystins in the water. The results will be correlated with visual observation of cyanobacteria blooms. Volunteers who wish to participate will attend a training day and collect a small water sample while they are monitoring. The procedure to conduct the test takes 35min to complete and the data will be submitted through a shared google sheet.

Monitoring Safety

Clean Lakes Alliance staff will inform volunteers via email when multiple volunteers and/or Public Health - Madison & Dane County report a cyanobacteria algal bloom presence. Clean Lakes Alliance recommends that volunteers take some safety precautions **during algal blooms events**:

- Do not enter the water
- Do not perform the measure of water temperature and water turbidity
- Limit your time nearby algal blooms while you are collecting visual information, to prevent breathing in bacteria

a. It's Blue, It's Green, It's Cyanobacteria!

What are cyanobacteria?

Cyanobacteria are a group of bacteria that photosynthesize and fix nitrogen

What does cyanobacteria look like?

Looks like blue-green paint across the surface of the water, and noticeably bacteria are disconnected and free-flowing

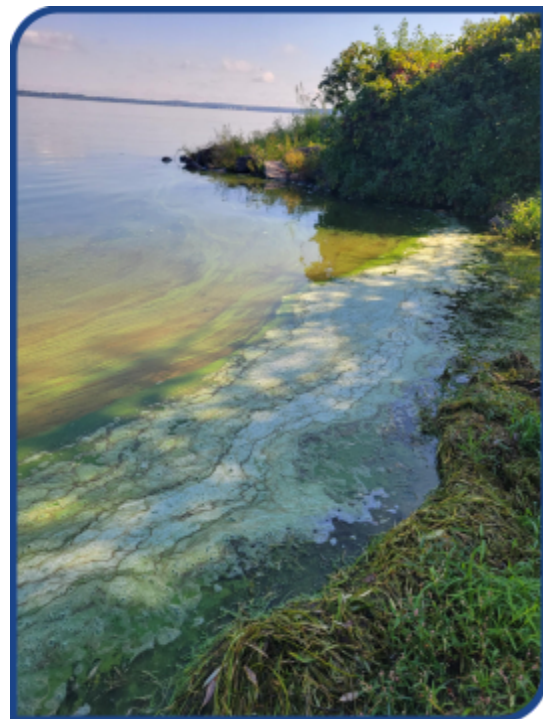
Why can cyanobacteria be harmful?

Some species produce **cyanotoxins** which can be hazardous to health when ingested, touched, or inhaled. **Cyanotoxins** are usually neurotoxic (affecting the nervous system) or hepatotoxic (affecting the liver).



Symptoms of Cyanobacterial Poisoning

- **In animals:**
 - Usually observable as soon as 20 minutes after ingestion
 - Weakness, staggering, difficulty breathing, convulsions, death
- **In humans:**
 - Cyanobacterial poisoning can occur in humans due to exposure to one of several neurotoxins (affecting the brain) or hepatotoxins (affecting the liver)
 - Microcystin-LR
 - Type: Hepatotoxin
 - Symptoms: Abdominal pain, headache, sore throat, vomiting/nausea, dry cough, diarrhea, blistering around the mouth, and pneumonia
 - Cylindrospermopsin
 - Type: Hepatotoxin
 - Symptoms: Fever, headache, vomiting, and bloody diarrhea
 - Anatoxin - A
 - Type: Neurotoxin
 - Symptoms: Tingling, burning, numbness, drowsiness, incoherent speech, salivation, respiratory paralysis (which could lead to death)





Cyanobacterial Poisoning Prevention Strategies

- Avoid contact with water known to be contaminated
- Rinse off with clean/fresh water as soon as possible if contact is suspected
- Do not ingest lake water
- Keep pets away from water and do not let them consume the water if unsure about water quality

IF YOU OR OTHERS BELIEVE YOU MAY HAVE CYANOBACTERIAL POISONING, SEEK MEDICAL HELP IMMEDIATELY!

b. Green Algae v. Cyanobacteria: Who's who?

	Green Algae	Cyanobacteria
What does it look like?	Long, green filaments that stick together in mats	Microscopic colonies or unconnected bacteria that flow over surfaces and look like paint
ID Pictures:		
Why is it bad?	In excess, mats can grow too thick and trap oxygen from photosynthesis, and float to the lake's surface	It is toxic and can make people and animals sick
Notable changes	Turns brown while decaying	Turns blue, white, or other bright colors while decaying
Differences between species:	<ul style="list-style-type: none"> • <i>Spirogyra</i> forms long, unbranched filaments • <i>Cladophora</i> feels like wet cotton, has branched filaments, and grows on hard surfaces • <i>Pithopora</i> branches at right angles and is very coarse, with brownish resting cells in the filaments 	<ul style="list-style-type: none"> • <i>Aphanizomenon</i> looks like small grass clippings • <i>Microcystis</i> forms nearly microscopic globular colonies • <i>Gloetrichia</i> are spherical and made of a ton of small filaments attached to a common center

Remember!

If it's slimy and in mats, green algae filaments are back!

If it's disconnected and small, that's cyanobacteria's call!

c. E. Coli: What you need to know

What is E. Coli?

E. coli refers to a family of bacteria that can live in water, on food, and in the intestines of people and animals

What makes E. Coli dangerous?

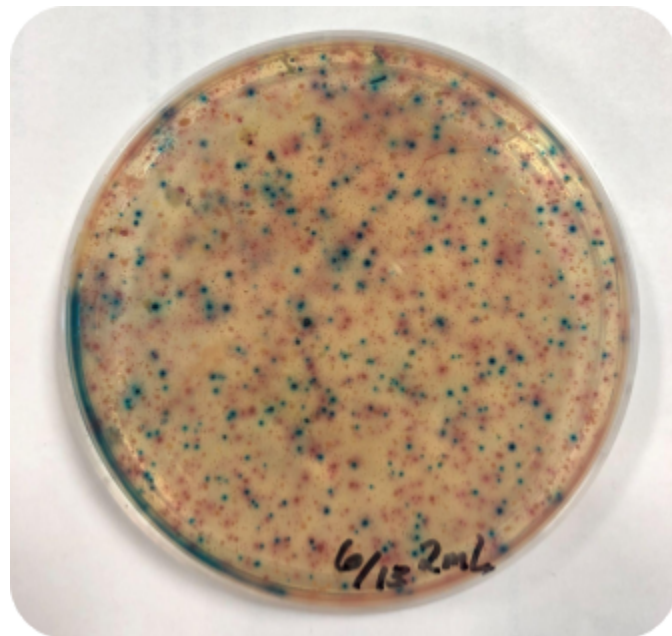
When ingested, *E. coli* can make people ill, and in extreme cases cause dehydration and death

Who monitors for E. Coli?

Public Health - Madison & Dane County conducts water quality checks once a week to look for *E. coli*

What triggers a beach closure?

Beach Closures occur when levels of *E. coli* or cyanobacteria are above a threshold (1,000 MPN/100mL or 20 ppb respectively). Closed beaches are tested daily until conditions improve.



E. Coli Contamination Symptoms:

- Diarrhea
- Abdominal cramping, pain, or tenderness
- Nausea and vomiting

Strategies to Prevent Contamination:

- Avoid swimming after heavy rainfall because levels could be elevated
- Do not ingest lake water and wash your hands before eating
- Wash your pet after swimming
- Follow safety alerts and advisories

Beach closures are posted on the Public Health - Madison & Dane County website, Facebook, and Twitter, in addition to email notifications and signage at the beach.

Annual Project Reporting

At the end of each year, Clean Lakes Alliance will compile and interpret both individual and aggregated sampling results. These results will be presented to volunteers via mail and in an annual report format. The end-of-year summary for each year can be found on Clean Lakes Alliance's Water Quality Monitoring webpage cleanlakesalliance.org/monitoring/. The information will also be shared with UW-Madison researchers as we continue to work toward developing a predictive model for cyanobacteria algal bloom formation. In addition, Clean Lakes Alliance will inform other water resources organizations of the data collected and facilitate its timely distribution.



How to Support our Monitoring Efforts

a. Become a Lake Forecasting Steward

If you would like to help support the program, please consider becoming a **Lake Forecasting Steward** or renewing starting at \$150 by going to our website cleanlakesalliance.org/product/lake-forecasting-steward/ or sending a check to Clean Lakes Alliance (150 E. Gilman St., Suite 2600, Madison, WI 53703) with memo “Lake Forecasting Steward.”

A *Lake Forecasting Steward* donation of \$150 contributes to the following:

- \$60.00: Turbidity tube for one additional volunteer & monitoring site
- \$35.00: Thermometer for one additional volunteer & monitoring site
- \$20.00: Office expenses and supplies
- \$35.00: 2022 Friend of Clean Lakes donation

b. Support with Pictures

Receiving pictures from you and your loved ones sampling at your sites will help us to promote and educate the public on the program through social media. Please send your action pictures while handling the material at your site to Clean Lakes Alliance staff. We would also like to receive pretty water scenes and/or algae blooms events pictures.



Contact Information

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Additional Resources

a. Aquatic Invasive Species

What are Aquatic Invasive Species (AIS)?

AIS are plants or animal species that are not native to the region and pose a threat to our waters. These species are a major threat to natural and cultural resources, ecosystem services, recreation, and tourism in the Yahara Watershed. AIS disrupt the ecological balance of our lakes; they can decrease water quality and can increase cyanobacterial growth. Not all non-native species are bad, but non-native species that do more harm to the local ecosystem than good are considered invasive, and therefore harmful. Invasive species compete with native species for access to resources, like food, because they have not evolved with any natural predators in the new ecosystem. Eventually, invasive species outcompete valuable native species in their habitat.

The impacts of AIS are not only costly to our lake health and ability to enjoy our lakes but also have an enormous economic impact. Researchers at the University of Wisconsin-Madison have found that a single non-native species has done \$80 to \$163 million in damage to a single lake ([UW](#)). Clean Lakes Alliance is committed to educating our volunteers and raising awareness of AIS in our watershed. Heightened awareness of AIS, how they are spread, and how they impact lake health is how the spread is prevented!

How are AIS Spread?

AIS can be spread intentionally or unintentionally but is almost always spread by humans. They are often brought into a new body of water via watercraft or aquatic equipment, which is why watercraft inspection at boat landings is so important. Cleaning, draining, and drying all watercraft and equipment is essential in preventing the unintentional spread of AIS. Some species have been introduced intentionally but later became an issue. For example, carp were originally introduced to be a game fish and a source of food. They quickly spread due to their ability to rapidly reproduce and tolerate a wide range of environments and have been damaging to native ecosystems.

What to do if you see an AIS?

As a volunteer monitor, it can be very helpful to report any suspected sightings of AIS to the Wisconsin Department of Natural Resources. To report a sighting, take a photo of the specimen, record any relevant details about the sighting, like the time, date, and exact location of the sighting, and report this information to the DNR AIS contact for Dane County, Shelby Adler, at shelby.adler@wisconsin.gov. In addition, please email any AIS sighting information to info@cleanlakesalliance.org. It can be helpful to collect a specimen, if safely possible. Refer to the [Wisconsin DNR website](#) for more information on reporting AIS.

Report AIS sightings and information to WI DNR contact for Dane County at
shelby.adler@wisconsin.gov

b. Emerging AIS Threats

While some invasive species are already well-established, some invasive species threats are still new or emerging in our watershed. There is a better chance of eradicating emerging threats early on, so here are some to look out for that you might see popping up around our lakes; make sure to report any sightings to the WI DNR!

Japanese Hops - (*Humulus japonicas*) - known from many sites in Southwest Wisconsin

Identifying Traits




- Green leaves with five to seven lobes, two to five inches long
- Leaves also have hook-shaped hairs
- Can grow up to 35 feet in a single growing season
- Stems have downward pointing prickles
- Can grow over other vegetation and overtake the area



Japanese Hops

Where you will see them

- They typically grow along the banks of rivers and streams
- The small hairs on the leaves can be irritating to the skin, so gloves are essential if you are taking a sample

Native Hops (<i>Humulus lupulus</i>)	Native Wild Cucumber (<i>Echinocystis lobata</i>)	
		

Not to be confused with: Native Hops (*Humulus lupulus*) or Native Wild Cucumber (*Echinocystis lobata*)

Red Swamp Crayfish - (*Procambarus clarkii*) - previously found in southern Wisconsin

Identifying Traits

- Two to five inches long
- Red with raised bright red spots
- Two front claws and eight legs
- Black, wedge-shaped stripe along its back

Where you will see them

- They are likely to be spotted in or near the water



Red Swamp Crayfish



Rusty Crayfish



Not to be confused with: Rusty Crayfish (*Orconectes rusticus*) or other native crayfish species (Not Pictured)

Yellow Floating Heart - (*Nymphoides peltata*) - previously found in southern Wisconsin



Identifying Traits

- The leaves are heart shaped and three to ten centimeters across, growing in dense patches
- Leaves float on the water's surface and have wavy edges
- Two to five small yellow flowers
- Flowers have five petals and measure three to four centimeters across



Where you will see it

- Yellow floating heart will float on top of the water, often covering large areas

Spatterdocks (<i>Nuphar lutea</i>)	Water Shield (<i>Brasenia schreberi</i>)
	

Not to be confused with: Spatterdocks (*Nuphar lutea*) or Water shield (*Brasenia schreberi*)

Starry Stonewort (*Nitellopsis obtusa*) - documented in many Southeastern Wisconsin lakes, and is spreading north and northwest

Identifying Traits

- Green plants with whorls of four to six leaves that have blunt tips
- Irregular lengths of leaves are arranged along the main stem
- Star-shaped bulbils are produced at the nodes, have five or more points, and are three to six mm wide
- Can grow up to seven feet tall in deep water
- Outcompetes and overtakes native plants, which negatively affects aquatic species that feed on smaller native plants



Where you will see it

- Typically in deep water, which makes it difficult to identify as a nearshore monitor
- Hand-pulling it is the best way to collect a specimen, if possible
- Starry Stonewort can grow in a variety conditions of gravel or sand, sun or shady areas

Nitella	Chara
	

Not to be confused with: Nitella or Chara (Both genera of algae)

Additional AIS Resources

While these are great examples of emerging AIS, information on established threats, like [Zebra Mussels](#), [Carp](#), and the [Spiny Water Flea](#) can be found on the Clean Lakes Alliance website. More information about AIS can be found on the [WI DNR website](#) or through the links below.

- [Wisconsin Aquatic Invasive Species Early Detector Handbook](#)
 - [AIS Fact Sheets](#) (Near the bottom of the page)
 - Clean Lakes Alliance [Clean Boats. Clean Waters](#) Initiative
 - To get more involved with AIS monitoring, visit the WI DNR [Aquatic and Wetland Invasives Species Monitoring](#) page
-

Turbidity, Clarity, and Total Suspended Solids

Parameters	Clarity	Turbidity	Total Suspended Solids (TSS)
Definition	How far light can pass through the water column.	Measure of the degree to which water loses its transparency.	Particles that are larger than 2 microns are found in the water column.
Comments	Turbidity and clarity are directly related. In fact, turbidity is a measure of water clarity. <i>High turbidity = Low clarity</i> <i>Low turbidity = High clarity</i>		While TSS affects turbidity, turbidity is not a direct measurement of TSS.
What is measured?	Organic and inorganic suspended solids, like clay, silt, sediment, algae, and bacteria + Dissolved colored materials (smaller than 2 microns)		Organic and inorganic suspended solids + Settleable solids (Solids that are moved along the bottom of a body of water by strong flow)
How is it measured?	<u>Direct measurement:</u> Turbidimeter or Turbidity Sensor <u>Indirect measurement:</u> Secchi disk or Turbidity Tube Indirect methods are quick and inexpensive but are dependent on the visual acuity of the observer		To measure TSS, a water sample is filtered, dried, and weighed.

Understanding Your Data: What Affects Water Clarity?

Amount of sunlight available

The measurement of water clarity using the Secchi disk and Turbidity tube is affected by the visual acuity of the observer, cloud cover, sun position, and lake surface state. If the sky is clear and the lake surface is calm, the Secchi disk will be more visible to the observer (Figure 1).



Figure 1: Monitor taking a Secchi disk reading during ideal weather conditions.

Inorganic suspended solids

In lakes, inorganic sediments such as clay, silt, and sand come from rivers, streams, and land use activities in the watershed. Soil erosion and runoff increase the amount of sediment in the water column (Figure 2). Those solid particles eventually settle down at the bottom of water bodies but seasonal mixing, boat activities, wind-generated waves, and certain fish species can stir them up and make the lake appear murky.

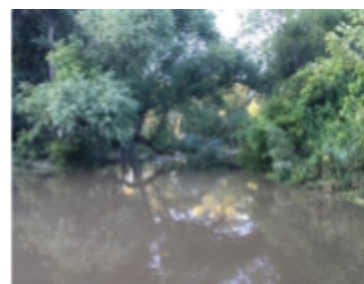


Figure 2: Suspended sediments after intense rainfalls in Pheasant Branch Creek.

Organic suspended solids

Algae (small aquatic plants), phytoplankton (microscopic plants), and zooplankton (microscopic animals) are suspended organisms that can affect water clarity. In particular, cyanobacteria can grow very quickly and impact the entire food web by significantly reducing light penetration, depleting oxygen during die-off, and producing toxins (Figure 3).



Figure 3: Cyanobacteria bloom on Mendota Lake.

Dissolved colored solids

Particles that are smaller than 2 microns are considered dissolved solids. Some of these dissolved solids give a color to the water which affects water clarity. For example, lakes near acidic wetlands might be stained brown due to dissolved tannic acid in the water (Figure 4).



Figure 4: Characteristic brown tea color that is the result of dissolved tannic acid.