HARMFUL ALGAL BLOOMS IN MICHIGAN

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Harmful Algal Blooms in Michigan

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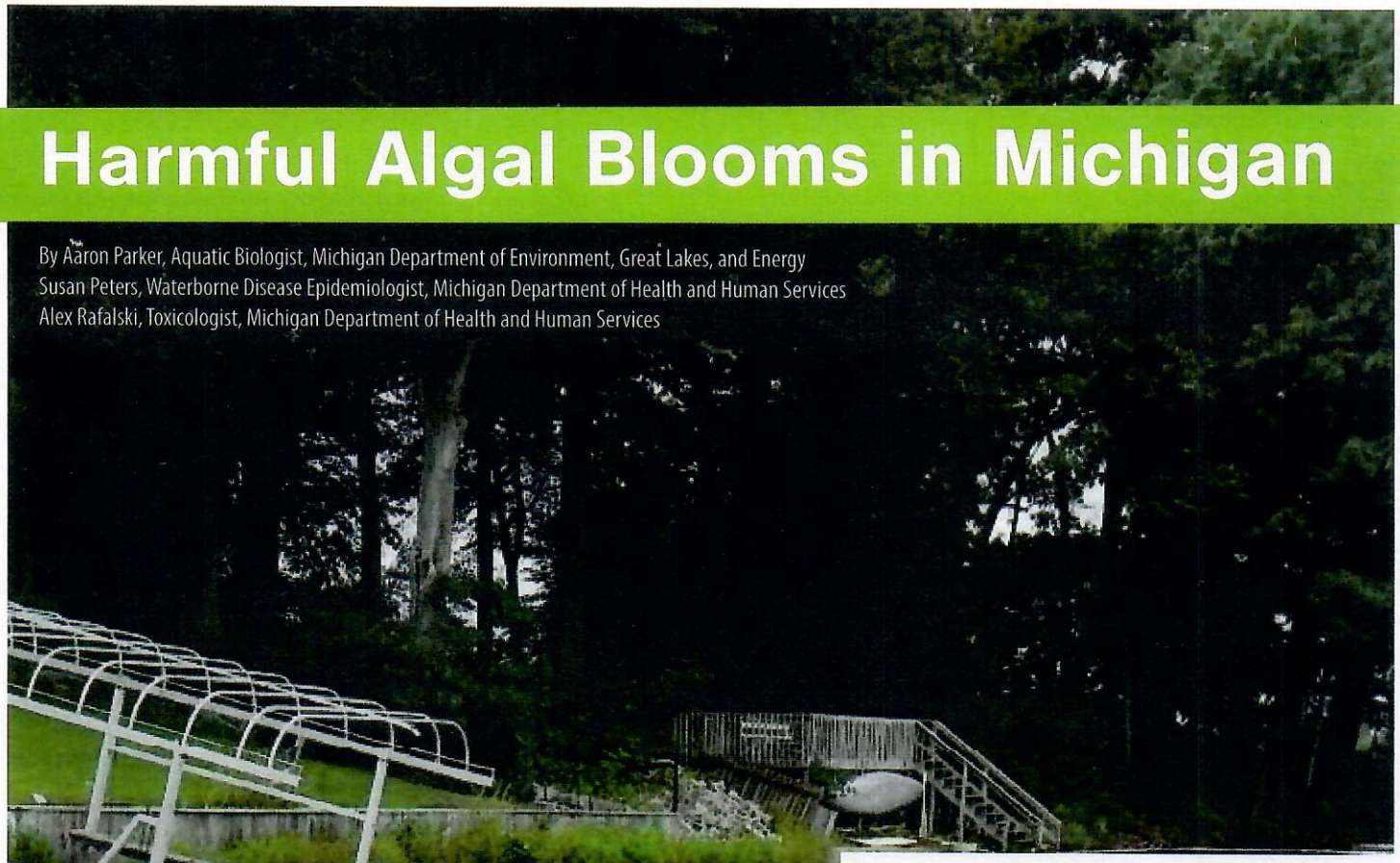

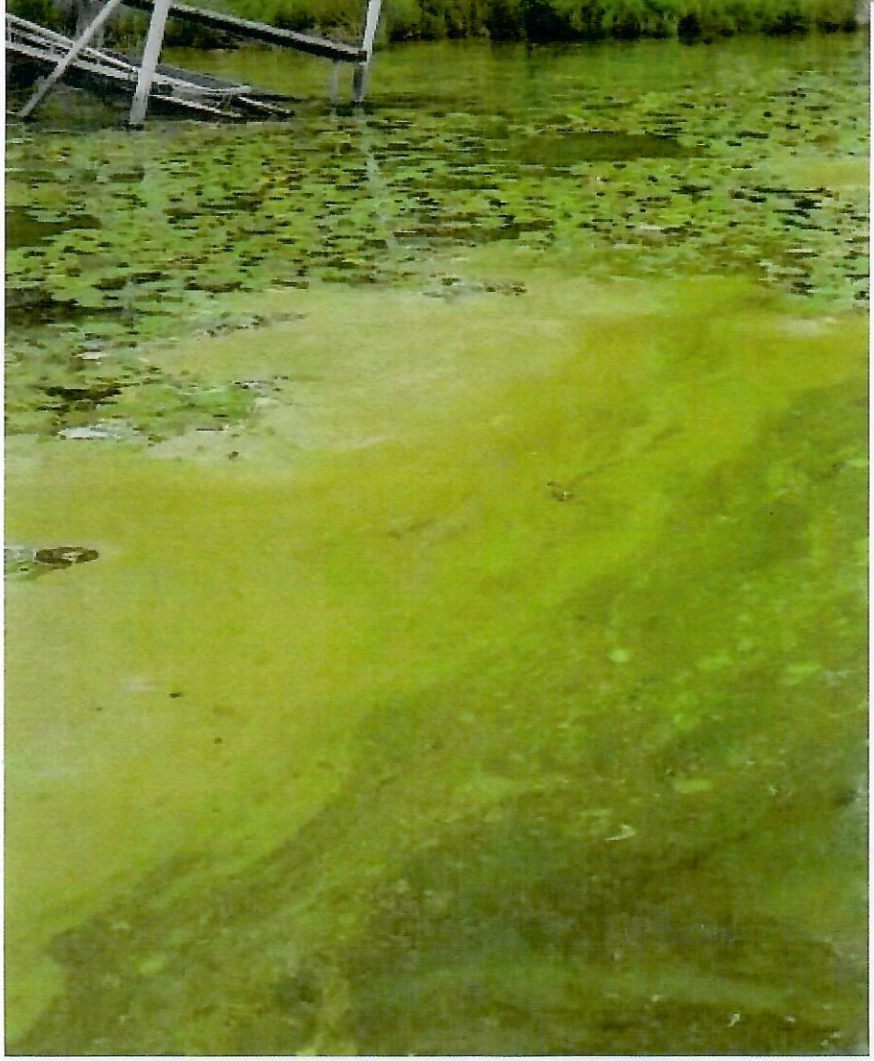

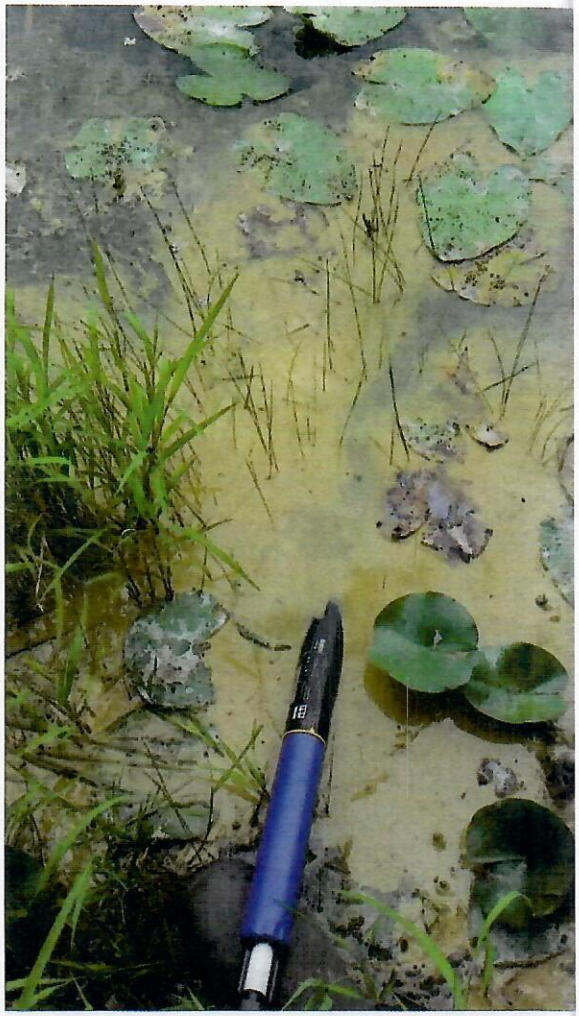

Cyanobacteria (also referred to as blue-green algae) are one of the oldest life forms on earth and can adapt to living in a wide variety of conditions in terrestrial, marine, and freshwater environments. Cyanobacteria thrive best in freshwater and, under certain conditions, they can form surface blooms that are not aesthetically pleasing, emit foul odors, and can interfere with recreational activities. Some cyanobacterial blooms are capable of producing cyanotoxins that can cause illnesses and even death in humans and animals; these blooms are known as harmful algal blooms or HABs.

Cyanobacterial blooms and their harmful effects on animals have been documented back to the 19th century (Francis 1878). Globally, the frequency, magnitude, and duration of cyanobacterial blooms has increased, with most researchers citing climate change, nutrient pollution, and invasive species as the largest causes of blooms (Ho et al. 2019). Cyanobacteria will typically reach bloom proportions in high nutrient waterbodies; however, they can also bloom in low and medium nutrient waterbodies that have been invaded by zebra and/or quagga mussels (Raikow et al. 2004). These invasive mussels will readily feed on diatoms and green algae but will not necessarily feed on cyanobacteria, which allows the cyanobacteria to proliferate (Vanderploeg et al. 2001).

When ideal conditions exist in a waterbody, either because of nutrients or invasive mussels, cyanobacteria can reach bloom proportions when water temperatures are warm (77° F and higher; Giannuzzi 2018), the water surface is calm, and plenty of sunlight is available. In Michigan, cyanobacterial blooms usually occur in June through October, with the majority of blooms being in August and September. Depending on the extent of those conditions, cyanobacterial blooms can persist for as little as one day or as long as several weeks. Cyanobacterial blooms tend to occur in patches throughout a lake, or even in one localized area, often along windswept shorelines.

Cyanobacterial blooms can be a variety of colors and textures, with an appearance that can look like scum, spilled paint, foam, or discoloration of the water (**Figure 1**). Many blooms are bright green with a "pea soup" appearance. Green algae, aquatic vegetation, duckweed, and oil sheens are sometimes mistaken for cyanobacteria blooms. Some blooms will turn a light blue or teal color as they die off.

Some common freshwater cyanotoxins that are known to cause illnesses in humans and animals include microcystin, cylindrospermopsin, anatoxin, and saxitoxin (Carmichael 2001). Within each of these classes of cyanotoxins, there are different known variants or congeners. From sampling across the state (described below), microcystin is the most common cyanotoxin detected in Michigan waterbodies (EGLE 2020b). The severity of symptoms humans and animals might experience from recreational contact with cyanobacterial blooms depends on how they were exposed, how long and the amount they were exposed to, and an individual's health. Swallowing water that contains cyanotoxins may make humans and animals feel sick to their stomach, including symptoms such as abdominal pain, vomiting, and diarrhea. Contact with water that contains cyanobacteria may cause irritation, leading to rashes, runny eyes and noses, or asthma-like symptoms. Swallowing a large amount or frequently swallowing water that contains cyanotoxins can cause nervous system, liver, or kidney damage, which can result in weakness, numbness, dizziness, or difficulty breathing in humans and animals. Dog deaths have occurred after drinking from waterbodies with cyanobacterial blooms containing anatoxin-a, including a confirmed case in Michigan in 2019 (EGLE 2020a).

The Great Lakes region has been no exception to the global increase in cyanobacterial blooms. In 2014, a large, toxin-producing cyanobacterial bloom in Lake Erie infiltrated the drinking water supply for Toledo, Ohio and caused the city and several surrounding communities to lose drinking water access for three days. Starting in 2016, the Michigan Department of Environment, Great Lakes, and Energy (EGLE) has partnered with the Michigan Department of Health and Human Services (DHHS) to analyze cyanotoxin concentrations in water samples from Michigan lakes

Figure 1. *Green Cyanobacteria*
Photo Credit: Michigan Department of Environment, Great Lakes, and Energy.

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Harmful Algal Blooms in Michigan

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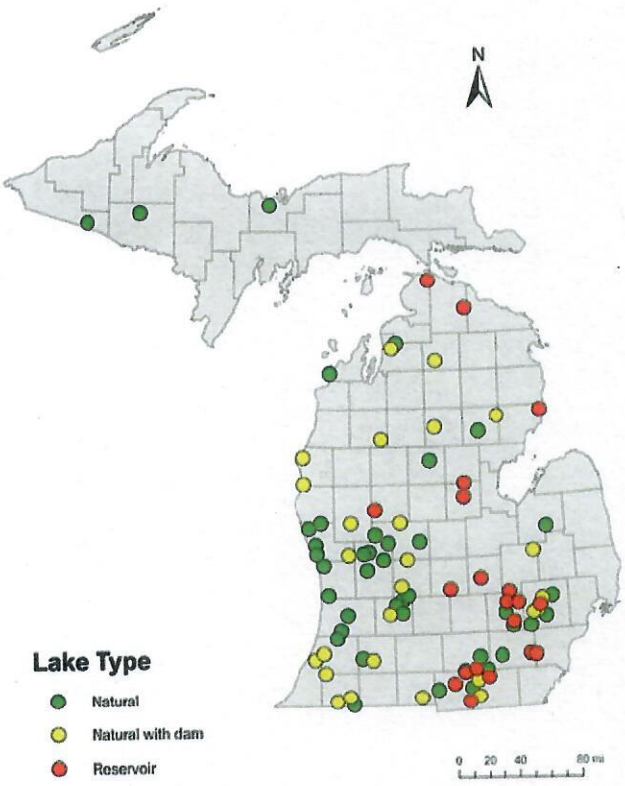

Figure 2. *Map of confirmed cyanobacterial blooms in Michigan lakes, by lake type, 2016-2019. Note: Map does not include five cyanobacterial blooms that occurred in Michigan rivers, wetlands, or private ponds.*

and communicate those results and any accompanying recreational risks to citizens and local health departments.

To date, water samples from 223 different Michigan waterbodies have been analyzed for cyanotoxins. One hundred of these waterbodies were lakes randomly chosen for sampling by the Michigan Department of Natural Resources (DNR) Fisheries Division. Of those randomly sampled lakes, only three had detections of the cyanotoxin microcystin, and none of those concentrations were above the U.S. Environmental Protection Agency's (EPA) recreational standard of 8 parts per billion. Based on this information, it has become evident that cyanobacterial blooms are not widespread throughout Michigan to the point that they are regularly found during random lake visits.

Rather, the majority of observed cyanobacterial blooms are ones that state and local agencies are alerted to by concerned citizens or lake management companies. In response to these reports, EGLE has confirmed cyanobacterial blooms in 93 different waterbodies throughout the state since 2016. The majority of those blooms have occurred in the southern half of the Lower Peninsula (**Figure 2**). EGLE sampling has also shown that during a cyanobacterial bloom, cyanotoxin concentrations change over time and are usually higher in areas with more cyanobacteria. While water with visible cyanobacterial blooms may contain cyanotoxins, clear water a few feet away typically has no toxins or very low toxin levels. These data support the advice that humans and pets should avoid areas with visible blooms, but unless the bloom covers a large portion of the waterbody, people and pets can typically use an unaffected area on the same waterbody.

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Blue Cyanobacteria
Photo Credit: Jaimee Desjardins, Professional Lake Management

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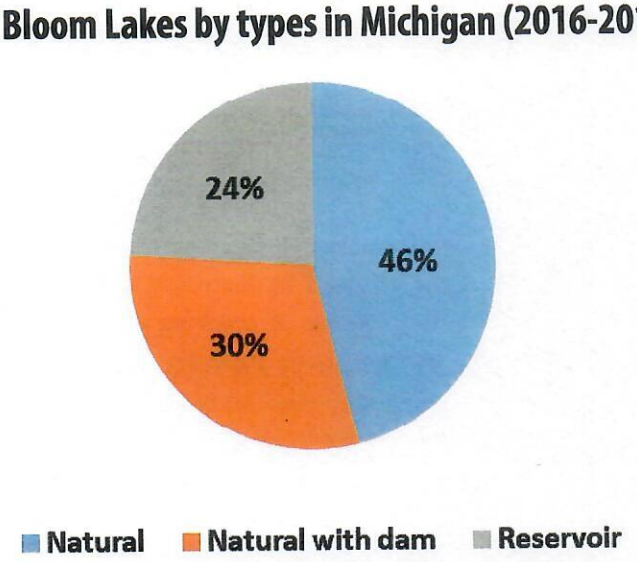

Figure 3. *Distribution of different lake types for Michigan lakes with confirmed cyanobacterial blooms, 2016-2019.*

Over half (54%) of the confirmed blooms have occurred in lakes that are impounded, such as reservoirs (lake systems created by placing a dam in a river or stream) or natural lakes that have a dam at their outlet that keeps the water level artificially high (**Figure 3**). In comparison, only around 10% of the lakes in the entire state are impounded in some way. Reservoir systems are often shallow, have numerous coves and embankments that are conducive to cyanobacteria growth, and tend to have larger watersheds that contribute nutrients to them. The reason why natural lakes with artificial dams tend to be over-represented amongst waterbodies that experience cyanobacterial blooms is less clear, since they tend to be deeper than reservoirs and maintain a similar shape to natural lakes with no dams. However, those lakes tend to be in more populated areas of the state, with more residents living on them. Thus, those lakes may experience more nutrient pollution from human activities.

Many agencies and organizations at the local, state, and federal levels collaborate on responses to cyanobacterial blooms. For blooms in Michigan, EGLE evaluates reports of suspected blooms, conducts field visits to confirm the presence of cyanobacterial blooms, and collects water samples for cyanotoxin testing when possible. Cyanotoxin testing is conducted at the MDHHS Bureau of Laboratories, and MDHHS communicates these results to the appropriate local health department. MDHHS and local health departments work together to assess potential public health risks from a cyanobacterial bloom and its test results, communicate these results to stakeholders, and conduct investigations into any cyanobacterial bloom-associated human illnesses. The Michigan Department of Agriculture and Rural Development (MDARD) is responsible for cyanobacterial bloom-associated animal illness investigations. These agencies, plus DNR, local health departments, and other federal partners in Michigan, coordinate this work through the Michigan Interagency Harmful Algal Bloom Workgroup. In addition, data from Michigan blooms is entered into the Center for Disease Control and Prevention's OHHABS reporting system to contribute to national cyanobacterial surveillance and research.

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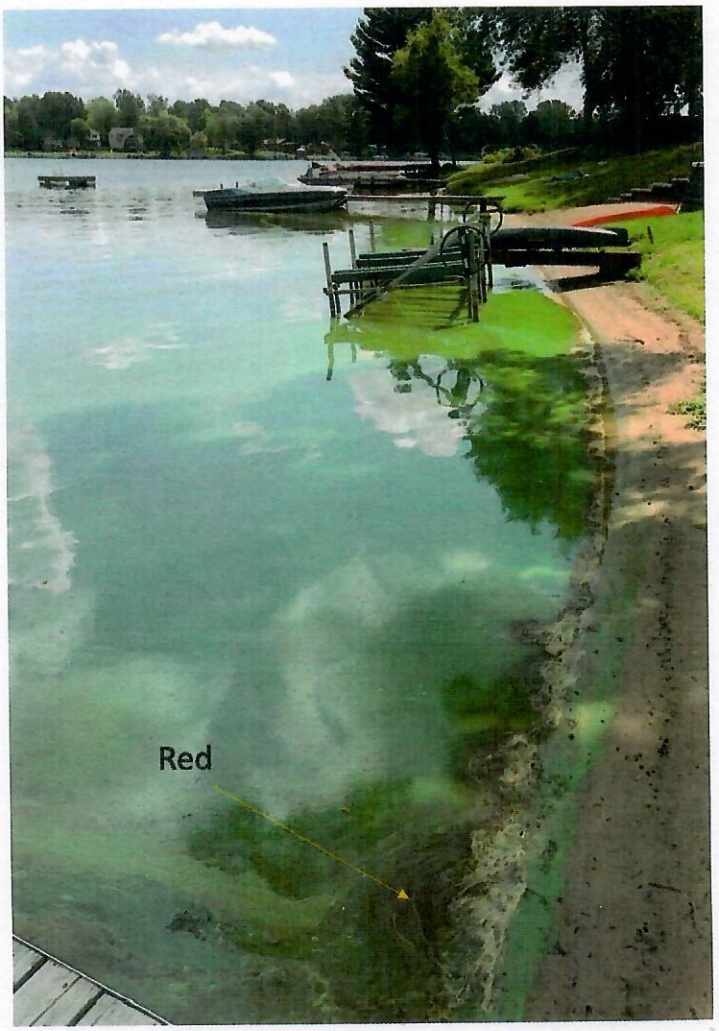

Red Cyanobacteria
Photo Credit: Michigan Department of Environment, Great Lakes, and Energy.

Harmful Algal Blooms in Michigan

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Everyone's help is needed to identify harmful algal blooms in Michigan! Any suspicious-looking cyanobacteria, algae, or bloom-related illnesses can be reported to EGLE by calling the Environmental Assistance Center at 1-800-662-9278 or sending an e-mail to AlgaeBloom@Michigan.gov. If available, any pictures of suspected blooms are greatly appreciated.

For more information on harmful algal blooms in Michigan, please visit www.michigan.gov/habs.

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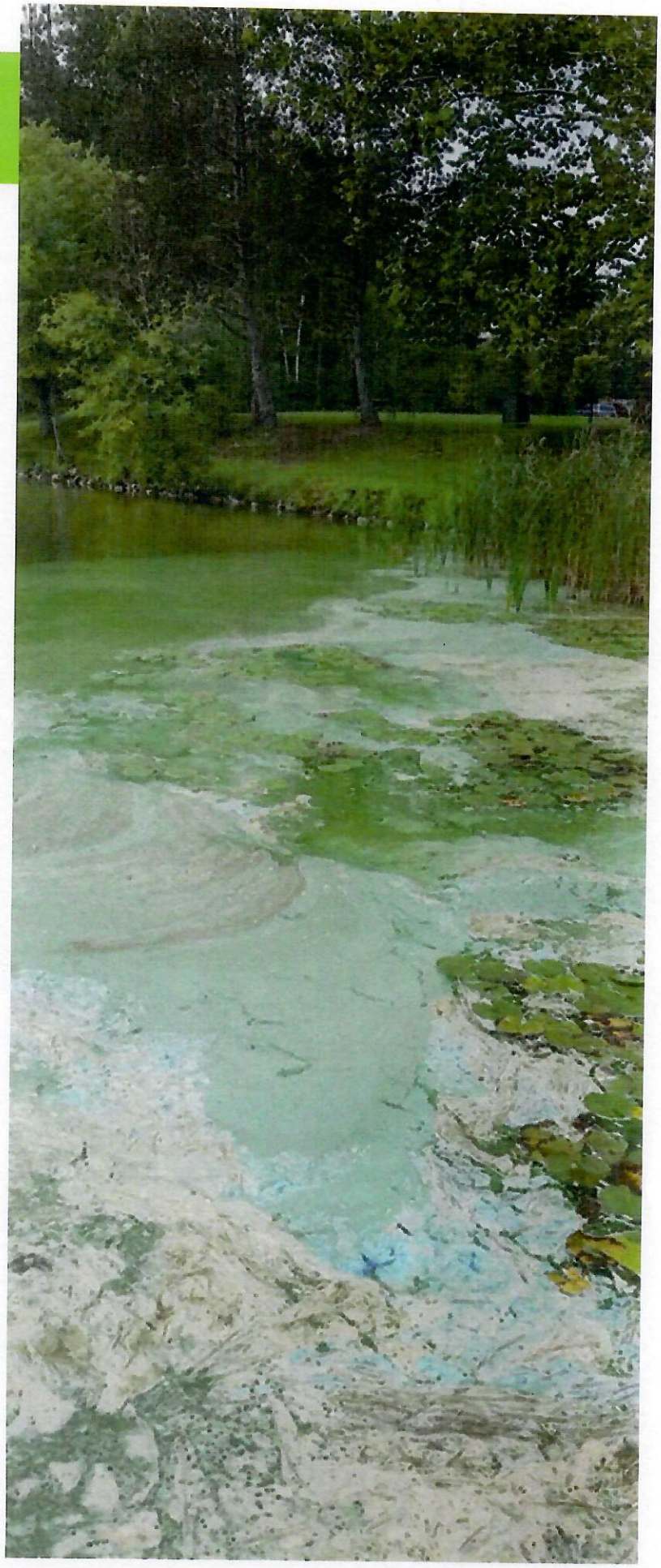

Blue Cyanobacteria
Photo Credit: Michigan Department of Environment, Great Lakes, and Energy.