Background

Cooks Pond is a shallow, 22-acre waterbody located in western Worcester near the Tatnuck neighborhood. It is approximately 11 feet deep at its deepest point, which is located in the southeastern portion of the reservoir, near the dam. Cooks Pond is situated in the middle of a chain of mill ponds along Tatnuck Brook, which extends south from Holden and was dammed in the 1830s to create a storage pond for a grist mill.

Cooks Pond is bordered on the west by Olean Street, a moderately trafficked roadway. The majority of the shoreline is forested and owned by the Smith's Pond Corporation, whose members collaborated with the Greater Worcester Land Trust and the City of Worcester to preserve the area through a 2007 conservation restriction that has provided public access to much of the land around the pond and protects it from development. Cooks Pond additionally serves as a recreational resource for fishing, paddling, and wildlife viewing. In 2022, researchers and students from Worcester State University (WSU) teamed up with the City of Worcester's Lakes and Ponds Program (L&P) to study Patch Reservoir and Cooks Pond using the Quality Assurance Project Plan (QAPP) developed by L&P to better understand water quality in these locations compared to other waterbodies in the city.

Water Quality Summary

As a suburban lake, Cooks Pond endures many of the pressures of the city. However, support of the waterbody by community groups and the City of Worcester have helped Cooks Pond continue to be a fantastic recreational resource. While invasive aquatic plants have been observed in the pond, the adaptable management plan has been effective at keeping invasive aquatic plants in low quantities. The pond generally has low concentrations of phosphorus and fair water clarity for an urban lake. Levels of bacteria were found to be outside the safe range for bathing and for several days in July 2021, but no closures were required prior to this date or have been necessary since then. Since beginning participation with the Worcester Cyanobacteria Monitoring Collaborative (WCMC) in 2018, no cyanobacteria blooms have been identified at Cooks Pond.

Management Summary

Since 1912, Cooks Pond and the surrounding property has been managed by recreational and conservation clubs with a mission to preserve and maintain the property. The current Smith's Pond Corporation Board oversees the management and financials associated with the property and pond. A Water Quality Standing Committee was formed in 2017, charged with identifying and coordinating conservation initiatives related to the pond's aquatic resources. Since 2017, the committee and club members have conducted visual inspections and hand removal of invasive water chestnut (*Trapa natans*). In 2020, the Committee engaged The Pond and Lake Connection to conduct a Sonar (trade name: Fluridone) treatment throughout the pond. This treatment resulted in a ~ 90% decrease in invasive aquatic plants such as Fanwort and Variable Milfoil.

Figure 1 – *WSU students and staff sampling for water quality at the Cooks Pond Dam.*

Sampling Analysis and Overview

Cooks Pond was visited twice monthly in 2022 from May through October and sampled at five locations: the major aboveground tributary, Tatnuck Brook; two smaller tributaries (Cascades stream and a stream exiting from near Donkers farm); the deepest part of the reservoir, and the outlet at the spillway located in the southern portion of the reservoir (see *Figure 2*). At the in-lake locations, probe measurements and water samples were collected one 1 foot below the surface of the water ("surface"), and two 2 feet off of the bottom of the lake ("bottom"). Parameters evaluated included: Secchi depth, temperature, dissolved oxygen (DO), pH, total phosphorus (TP), and total dissolved phosphorus (TDP). Samples analyzed for total suspended solids (TSS), ammonia (NH_3), and nitrate (NO_3) were collected on a monthly basis. Altogether, there were 12 sampling events. For 5 of these events, there had been no rainfall for 24 hours prior to data collection. However, on 7-Jul, there were 1.47 inches of rain in the 24 hours prior to

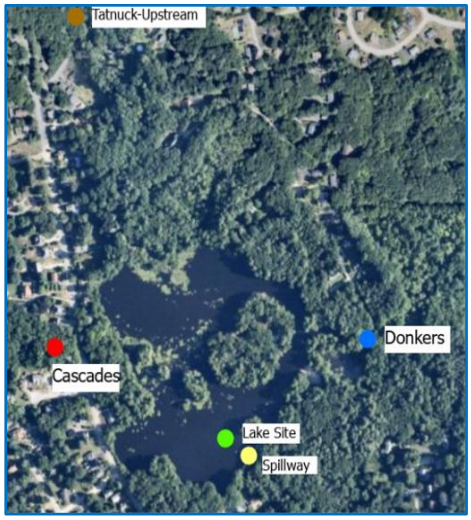


Figure 2 – *Cooks Pond map and approximate sampling locations.*

sampling, on 23-Sep there were 0.44 inches of rain, and on 6-Oct there were 0.26 inches of rain. These days are categorized as "wet weather" sampling events and are marked with the symbol on the figures in this report.

In addition to monitoring by WSU, volunteers from the WCMC collected samples for phycocyanin and relative cyanobacteria density analysis to assess bloom risk. Samples were taken twice monthly between May and October, on 21- May, 6-Jun, 18-Jun, 5-Jul, 16-Jul, 1-Aug, 27-Aug, 12-Sep, 24-Sep, 3- Oct, and 15-Oct. The Worcester Department of Inspectional Services tested the pond for *E. coli* as an indicator for harmful bacteria on a weekly basis during the summer months.

Raw data are displayed and explained below. No statistical analysis has been performed. Subsequent ratings of "Excellent", "Good", "Fair", and "Poor" for reported values are based on the Massachusetts Department of Environmental Protections SMART Monitoring Watershed Report Card Criteria.

Quality Assurance/Quality Control

Worcester State University and The Lakes and Ponds Program strive to have a robust data set. WSU therefore used Quality Assurance/Quality Control (QAQC) checks to ensure that the data were representative of local conditions and meet precision and accuracy standards. Review of QAQC check results identifies data that need to be flagged and/or censored before they are shared and can highlight issues that affect data quality. When data failed to meet acceptable criteria for these checks, they were marked with a red flag as approaching the QAQC standard. In this report, we have opted not to censor any data; however, data that fell outside of the range for the QAQC check has been marked with the symbol ⊗ and should be treated with caution. For more information on WSU's data quality, please contact laura.reynolds@worcester.edu.

Table 1 *- There were no threshold exceedances for bacteria Cooks Pond in 2022, with all results within the ranges considered "Excellent" and "Good".*

2022 E. COLI RESULTS	
DATE	RESULT
6/27/2022	20
7/5/2022	36
7/11/2022	16
7/18/2022	8
7/25/2022	16
8/1/2022	24
8/9/2022	96
8/15/2022	8
8/22/2022	16
8/29/2022	32
9/6/2022	136

Excellent	Good
Fair	Poor
Results in colonies/100 ml	

Fecal Bacteria

Recreational contact with water contaminated by certain fecal bacteria may cause illness. *Escherichia coli*, or *E. coli,* are a type of bacteria found in the digestive tract of warm-blooded animals including geese, pets, and humans. While most strains are harmless, some can make you very sick. These bacteria enter the water in many ways, including direct contact with animal waste, runoff from the shoreline and impervious surfaces like paved roadways during rainstorms, leaking septic tanks, and illicit sewer connections that empty sewage to the stormwater system. The Commonwealth of Massachusetts has strict regulations for bathing beaches, and Worcester Inspectional Services collected samples for *E. coli* weekly at public beaches during the swimming season to ensure that the water is safe for direct contact, closing beaches if the results were above the recreational threshold.

Fecal Bacteria at Cooks Pond. There were no exceedances of the recreational threshold for bacteria at Cooks Pond in 2022 (*see Table 1*). Results of beach *E. coli* testing by Worcester Inspectional Services ranged between 8 and 136 cells/ 100ml, with most results falling into the "Excellent" category as determined by DEP.

Water Clarity

Water clarity is a measure of the transparency of water. Algae, microscopic organisms, eroded particles, and re-suspended bottom sediments are factors that interfere with light penetration and reduce water transparency. Clear water allows sunlight to penetrate the depths of a waterbody, supporting growth of aquatic plants, which provide food, shelter, and oxygen to aquatic organisms. Clear water is also pleasant to the eye and safer for recreational contact. Turbid water, or water filled with particles, absorbs more heat from sunlight. This reduces the water's capacity to hold oxygen, creating favorable conditions for algal and cyanobacteria blooms, which further reduce clarity. Water clarity can be measured with a Secchi disk or by quantifying total suspended solids (TSS). A Secchi disk is a weighted black and white disk on a calibrated line that is lowered into the water until it is no longer visible. Secchi readings are collected on each lake visit by WSU. TSS is a measure of the dry weight of suspended particles in a given amount of water. TSS samples were taken monthly and submitted to an external lab for analysis.

Water Clarity at Cooks Pond. At Cooks Pond, Secchi depth was rated as "Poor" and "Fair" throughout the season, with a maximum clarity of 8 feet in early May (see *Figure 4*). As the season went on, Secchi depth fell to below 4 feet into the category considered "Poor" on three occasions, coinciding with increases in phycocyanin concentrations. The minimum recorded clarity of 3.0 feet was recorded on 18-Aug. Results for TSS were generally below detectable limits in four of six sampling events both in the surface and deep sites. Water clarity in Cooks Pond was rated "Fair" in 2022.

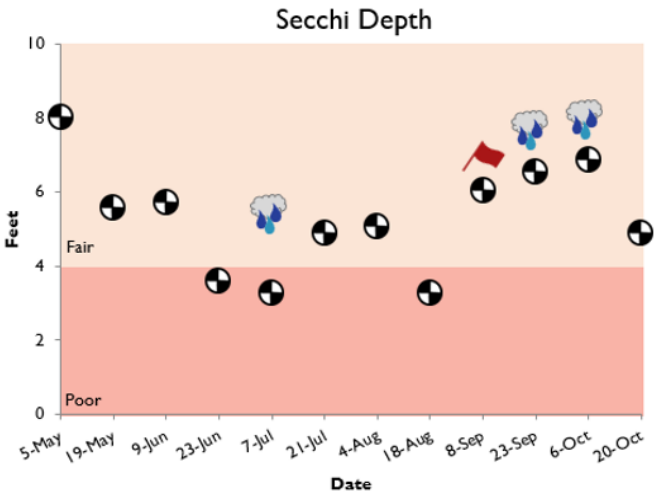


Figure 4 – *Secchi depth ranged between 3 and 8.2 feet, falling in the ranges considered "Poor" and "Fair".*

Temperature

Water temperature is important for understanding both the biology and chemistry of aquatic ecosystems. Because many organisms prefer to live in a narrow temperature range, understanding temperature across the area and depth of a water body is essential. Temperature is also a determining factor in the speed of chemical reactions and the ability of water to hold oxygen. As temperature increases, water can hold less dissolved oxygen. Temperature dynamics in lakes can also determine the level of mixing experienced throughout the water body, affecting the distribution of oxygen, nutrients, and organic matter throughout the lake. Temperature was measured using a temperature sensor on a handheld probe at the water's surface, and two feet from the bottom at the in-lake locations during every sampling event.

Temperature at Cooks Pond. Surface temperature at Cooks Pond rose throughout the beginning of the season until reaching a maximum recorded temperature of 28.4°C on 21-Jul, which was one of two results considered "Poor" (*see Figure 5*). Bottom temperature followed a similar pattern, with the maximum temperature of 23.9°C recorded on 4-Aug. After reaching its peak, temperature began to decrease to the lowest of the season, 12.0°C at the surface and bottom on 20-Oct. Temperature at Cooks Pond followed the expected seasonal distribution and was rated overall as "Excellent".

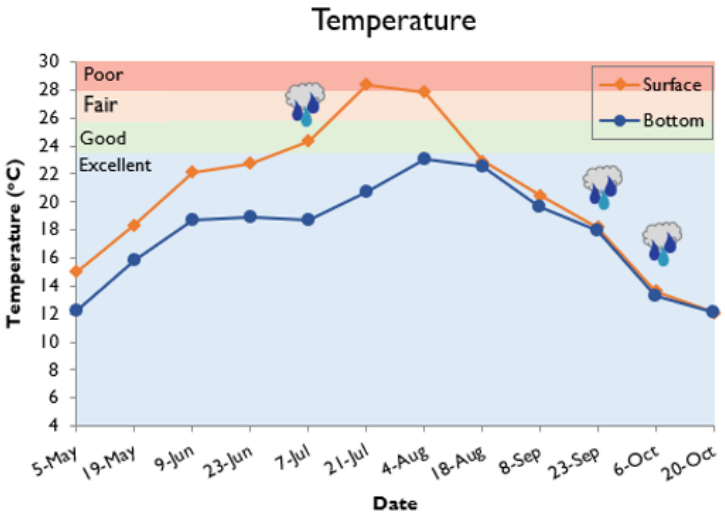


Figure 5 – *Surface temperature readings generally exceeded bottom temperature, following the expected seasonal distribution. Surface temperature ranged between the "Excellent" and "Poor" categories, while bottom temperature was consistently considered "Excellent".*

Dissolved Oxygen

Oxygen dissolved in water is essential to aquatic life just as it is to life on land. Dissolved oxygen (DO) is a highly variable parameter that is controlled by many factors, including temperature, pressure, aeration, diffusion, rate of photosynthesis, rate of respiration and more. When water temperature rises, water can hold less dissolved oxygen, potentially causing stress to aquatic organisms. Thermal stratification, which is layering in the water column based on temperature, can also create a barrier to waterbody mixing, creating areas with depleted DO in some deeper portions of waterbodies. Increased algal growth followed by excessive decomposition of organic material can also lead to low oxygen conditions, potentially causing fish kills. DO was measured using a galvanic DO sensor on a handheld probe at the water's surface, and two feet from the bottom at the in-lake locations during every sampling event.

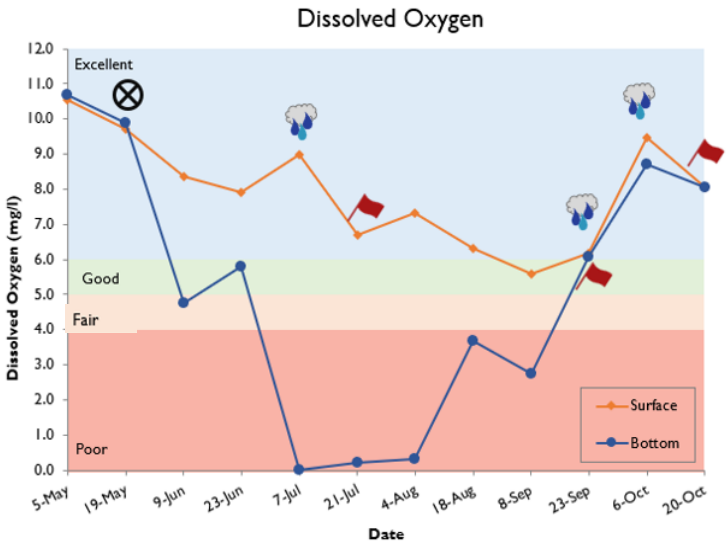


Figure 6 – *Surface DO was considered "Excellent" for the entire season at Cooks Pond. Readings at the bottom of the lake were in the "Excellent" range at the beginning and end of the season but decreased to "Poor" between July and early September.*

Dissolved Oxygen at Cooks Pond. In 2022, DO at the surface of Cooks Pond was above 6mg/l, or in the range considered "Excellent", on all but one occasion (see *Figure 6*). Surface DO ranged from 5.6 to 11.8 mg/l, starting the season higher and was generally lowest in the early Fall months (see *Figure 6*). Bottom DO readings indicated that the Cook's Pond experienced anoxic, or no-oxygen, conditions during the middle of the summer. DO ranged between 0.04 mg/l and 11.2 mg/l, with readings falling below 4 mg/l or in the range considered "Poor" between 7-Jul and 8-Sep. For the remainder of the season bottom DO readings were higher, in the ranges considered "Good" and "Excellent. DO at Cooks Pond in 2022 was rated "Good".

pH

pH is the concentration of hydrogen ions (H+) in a solution. The more H+ ions that are present, the more acidic the solution. On a scale of 0-14 units, 7 is a neutral pH. As pH increases from 7, the solution is more basic, and as pH decreases from 7, it becomes more acidic. In aquatic ecosystems, pH affects most chemical and biological processes including species distribution, growth rate, reproductive success, and nutrient dynamics in lakes. A high pH can promote chemical reactions that release phosphorus from lake sediments. Healthy lakes in this area have a pH between 6.5 and 8.5. pH was measured using an ion-selective electrode (ISE) pH sensor on a handheld monitoring probe. Readings were taken at the water's surface and two feet from the bottom.

pH at Cooks Pond. This year at Cooks Pond, pH values varied throughout the season mostly falling between 6.5 and 8.5, which is the healthy range for lakes in this region (see *Figure 7*). Surface pH ranged between 7.9 and 6.7 and tended to be higher than bottom pH which ranged between 4.3 and 7.0. Please note that QAQC challenges were common for these data and therefore should be treated with caution.

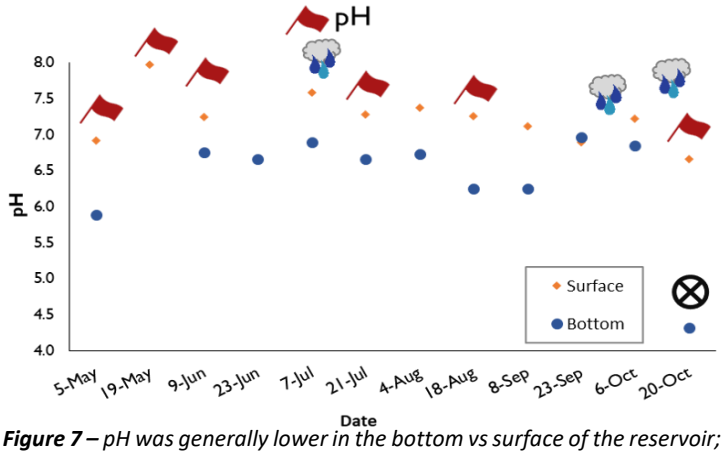


Figure 7 – *pH was generally lower in the bottom vs surface of the reservoir; however, all reliable results were in the expected and healthy range.*

Nutrients

Nutrients, primarily nitrogen (N) and phosphorus (P), are food sources for aquatic plants and algae. Although plants and algae are the basis of aquatic food chains, and necessary for a healthy lake ecosystem, an overabundance of nutrients can lead to issues such as harmful algal blooms and excessive plant growth. Common nutrient inputs to urban lakes and ponds include fertilizers, pet and goose waste, illicit sewer connections to the stormwater system, and runoff that flows over land into the stormwater system. Additionally, under the right conditions, P can be released from the sediments at the bottom of the lake, becoming more available for uptake by organisms. To examine the nutrients present in program lakes, L&P collected samples for several compounds and submits them to an external lab for analysis. To measure N, samples were collected for nitrate (NO_3) and ammonia (NH_3) at all sites monthly. To measure P, samples were collected for total phosphorus (TP) twice a month at all sites, and total dissolved

phosphorus (TDP) twice a month at all bottom sites. TDP was also analyzed to understand how much P is dissolved in the water and available for use by aquatic organisms.

Nutrients at Cooks Pond. Surface TP results in Cooks Pond ranged between 0.012 and 0.034 mg/l, with the lowest results at the beginning and end of the season and higher results, mostly considered "Good", during the summer months (see *Figure 8*). Bottom TP results followed a similar seasonal distribution but were generally higher than those at the surface, ranging between 0.017 and 0.058 mg/l, with the highest results in the range considered "Fair". In 2022, TP results in Cooks Pond were rated "Good".

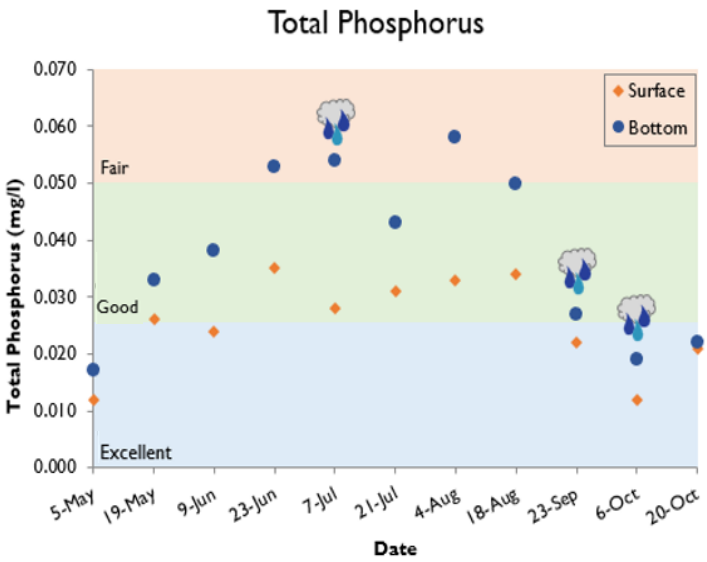


Figure 8 – *Surface TP results in Cooks Pond ranged between 0.012 and 0.034 mg/l and were considered "Excellent" and "Good". Bottom TP results were generally higher ranging between 0.017 and 0.058 mg/l, with the highest results in the range considered "Fair".*

Generally, NO_3 concentrations were low at all sites, with all results below the detection limit of 1 mg/l, which is indicative of an unpolluted waterbody. Surface results for NH_3 were below the detection limit of 1 mg/l for all dates except 18-Aug, in which the results were 0.094mg/l at the bottom and 0.18mg/l at the surface (see *Figure 9*). At the bottom of the lake, NH_3 remained in the range considered "Excellent" throughout the season. In 2022, results for NO_3 and NH_3 were rated "Excellent".

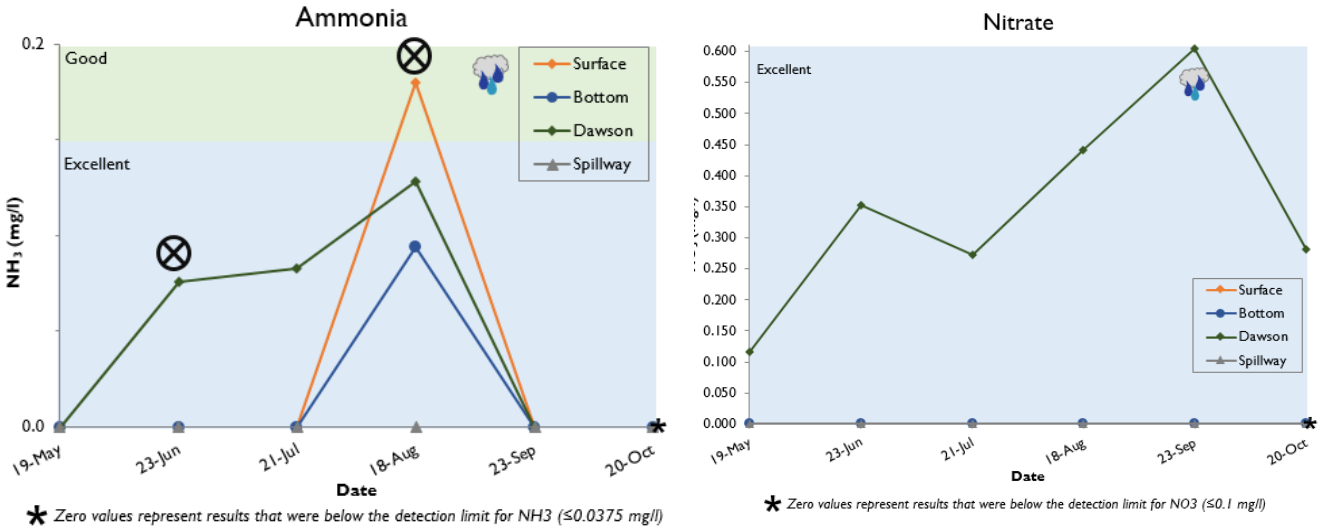


Figure 9 – *Ammonia (NH_3) concentrations ranged between undetected and 0.180 mg/l and fell within the "Excellent" and "Good" categories. NH_3 was always considered "Excellent" at the bottom of the pond and Tatnuck Brook at Dawson Road. NO_3 was only detectable in the main tributary, Tatnuck Brook at Dawon Road, with only one result above 0.6 mg/l .*

Cyanobacteria

Cyanobacteria are naturally occurring microorganisms in lakes and ponds. Using sunlight and nutrients such as N and P, cyanobacteria behave similarly to plants and algae. While normal at low densities in healthy ecosystems, under the right conditions, some species of cyanobacteria can reproduce quickly causing potentially harmful blooms. Cyanobacteria blooms, in addition to being unsightly and smelly, can produce toxins that are harmful to humans and pets. Blooms also have the potential to create anoxic conditions that can cause fish kills.

To understand the abundance of cyanobacteria and make decisions regarding lake management and safe access, the data collected by the Worcester Cyanobacteria Monitoring Collaborative (WCMC) were utilized to measure cyanobacteria indicators and estimate toxin exposure risk. The WCMC is a group of community science volunteers that collected water quality samples twice monthly between May and October at 24 waterbodies in and around Worcester, including Cooks Pond. Parameters examined included phycocyanin and the relative abundance of cyanobacteria taxa. Like chlorophyll, the pigment phycocyanin is used by cyanobacteria to harness the sun's energy, converting carbon dioxide to sugars for growth and reproduction. Because phycocyanin is unique to cyanobacteria, it can be used as an indicator of cyanobacteria's relative abundance in a waterbody. Cyanobacteria taxa and their relative density help determine what toxins may be present. The WCMC was also able to determine relative density of cyanobacteria genera in samples using a high-powered microscope. Using both phycocyanin and comparative cyanobacteria density the WCMC began to assign bloom risk at each participating waterbody. For more information on the WCMC and their results, visit WorcesterMA.gov/WCMC.

Cyanobacteria at Cooks Pond. Phycocyanin results remained low for the majority of the season but increased slightly in July and again in September (see *Figure 10*). Despite the two peaks in concentration, phycocyanin remained below the threshold of 50ug/l that is indicative of elevated bloom risk. Cyanobacteria did not require any management to avoid bloom conditions. Bloom risk was classified as either "Almost None" or "Low". Although they were not seen in high numbers, the cyanobacteria genera, *Dolichospermum, Aphanizomenon,* and *Woronichinia,* were observed. Cyanobacteria at Cooks pond was rated as "Excellent" in 2022.

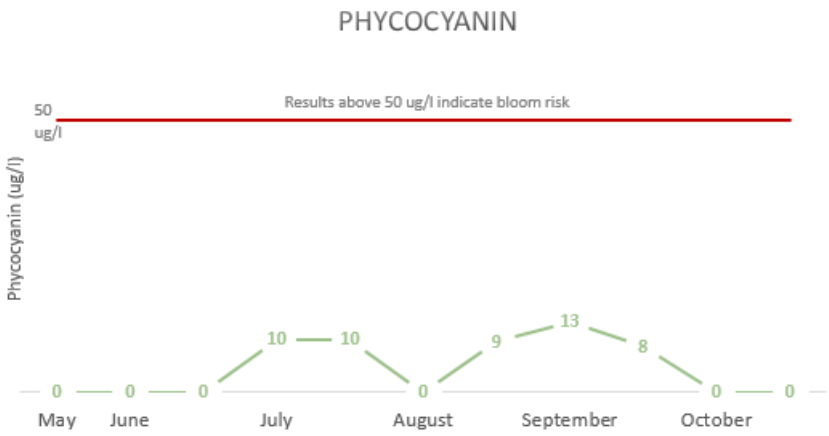


Figure 10 – *Phycocyanin results from Cooks Pond were generally low and remained below the concentration indicating bloom conditions all season.*

Invasive Aquatic Plants and Animals

Plants and animals are vital parts of any lake ecosystem. Plants provide food, shelter, and oxygen to other aquatic organisms. Their uptake of nutrients reduces the likelihood of algal blooms, and their root systems stabilize sediments. Animals play invaluable roles in food webs and their removal can disrupt the ecology of a system. An invasive plant or animal is an organism that is not native to the region and outcompetes local flora and fauna. The absence of natural constraints, like predators or environmental limitations, allows invasive plants and animals to reproduce at a rapid rate. When invasive aquatic plants and animals become too numerous or dominant, they can overtake all available space, disrupting local ecosystems and making recreation more difficult. Invasive organisms can arrive by hitching a ride on boats, pets, or boots to get to a new location. Some are released with good intentions as a beautiful addition to a landscape or sport fishing opportunity. Professional surveys and visual inspections from community members are used to make management decisions regarding invasive species.

Invasive Aquatic Plants and Animals at Cooks Pond. Several invasive species have been observed in Cooks Pond since observations began in 2017, including Water Chestnut (*Trapa natans*), Fanwort (*Cabomba caroliniana*), and Variable Milfoil (*Myriophyllum heterophyllum*) (see *Figure 11*). A 2018 aquatic plant survey conducted by Dr. Robert Bertin showed that Fanwort was abundant in over 90% of the pond, variable milfoil was present but sparse in several areas near the dam and beach, and water chestnut was rare (see *Figure 12*). Following this survey, a local Order of Conditions was applied for and approved, and the Smith's Pond Corporation hired a lake management company to manage invasive aquatic plants in 2020. The lake management company applied Fluriodne (trade name: Sonar) to the pond in May

Figure 11 – *Invasive aquatic Water Chestnut (*Trapa natans*).*

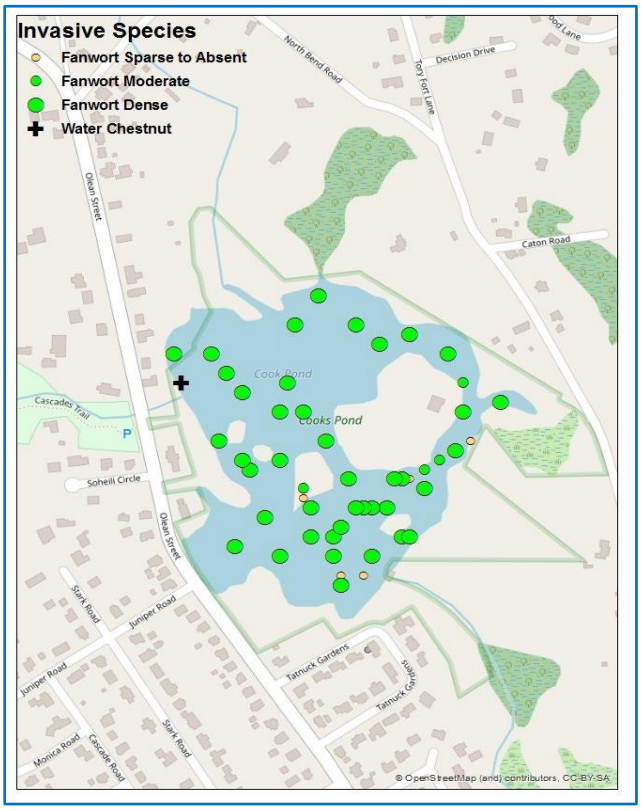


Figure 12 – *Invasive aquatic plant coverage in Cooks Pond in 2018 prior to treatment.*

2020 and resulted in a 90% reduction in invasive aquatic plants in 2021. In 2021, the lake management company applied a contact herbicide in several locations to manage larger patches of water chestnut and variable milfoil. Since 2021, volunteers have continued to hand pull any water chestnut observed and no further treatments have been applied.

Litter

Litter, or inappropriately disposed waste, is harmful to the ecological, aesthetic, and recreational value of lakes and ponds. Improperly discarded plastic and Styrofoam products can be mistaken as food by aquatic organisms and can kill them. Mounds of trash and rotting organic material can cause infestation by disease-carrying vermin. Additionally, they look and can smell unpleasant to beachgoers and hikers. Finally, sharp objects like syringes, broken metal, or glass can pose a threat to swimmers and other beach visitors.

Figure 13 *– Litter along trails near Cooks Pond*

Litter at Cooks Pond. Litter was collected throughout the sampling season whenever it was present but was generally rare in and around Cooks Pond (see *Figure 13*).

Tributaries

Tributaries are streams that flow into a lake or pond. They collect surface runoff from rain or snowmelt along with some groundwater and carry it through the stream channel to the waterbody. In some cases, tributaries make up a large portion of the water going into the lake, and the quality of the water in these tributaries can give us hints about where certain impairments in the lake are originating. Outlets are the major exits for water in the lake. Most of the abovementioned water quality parameters were measured at the major natural tributaries and outlets of the lake.

Tributaries at Cooks Pond. At Cooks Pond, the major natural tributary is Tatnuck Brook, which enters the pond from the north. The major outlet of the reservoir is the spillway, located on the southern end of the impoundment. Tatnuck Brook is considered to be a Coldwater Fish Resource (CFR), which means that it is a stream that can sustain cold water fish species such as Trout. Over the 2022 sampling season, the brook north of Cooks Pond (at Dawson Road) had a maximum temperature of 22.2°C on 21-Jul and was in the temperature range considered "Fair" for 2 of the 12 sampling events (see *Figure 14*). For the most part, the temperature in Tatnuck Brook at Dawson Road was in the “Good” or “Excellent” categories. As water from Tatnuck

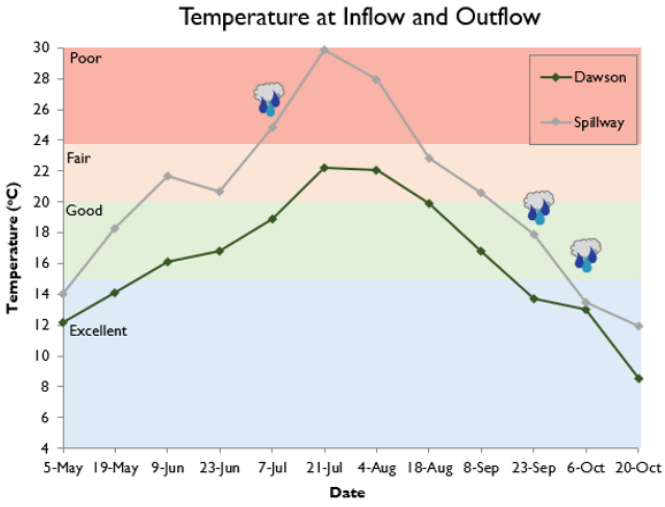


Figure 14 *– Water temperature at the Cooks Pond spillway was on average 3.5 degrees higher than when it entered.*

Brook enters Cooks Pond, it slows down and is more exposed to the sun and air, warming it up. On average, the water leaving the Cooks Pond spillway is 3.5 degrees higher than the water that enters the reservoir, and spillway water temperatures were considered "Poor" for three sampling events during the season.

DO readings (see *Figure 15*) were generally above 6 mg/l, falling in the ranges considered "Excellent" and "Good" until early September in both the inflow and outlet of Cooks Pond. Although DO concentration improved over the fall, stricter standards for DO in CFRs led to the readings being considered "Fair" and "Good" for the remainder of the season. Given this change in the rating scale, spillway DO values were considered "Poor" for both sampling dates in September, and "Good" in October.

TP in Tatnuck Brook was variable, ranging between undetected and 0.286 mg/l, although the data quality for the highest value is questionable and should be treated with caution (*see Figure 16*). In general, TP results were lower at the beginning and end of the season, with several results considered "Excellent", but the rest of the season had more results in the "Good" and "Poor" ranges. TP results at the spillway spanned between 0.012 mg/l and 0.045 mg/l and were in the ranges considered "Excellent and "Good" all season.

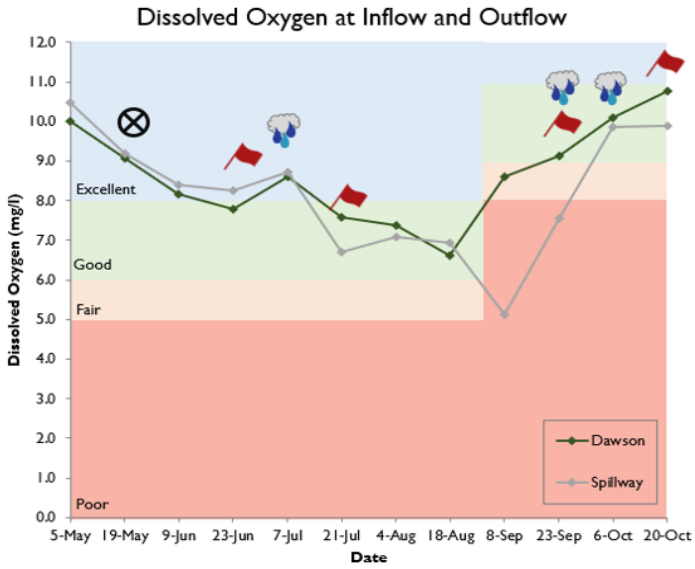
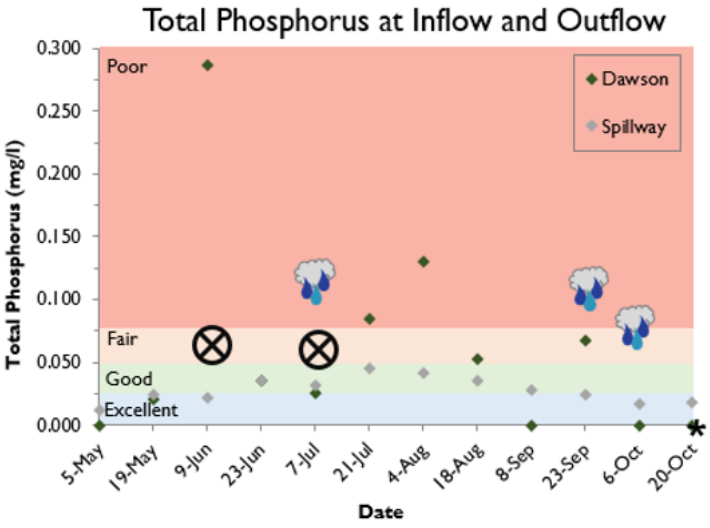


Figure 15 *– DO at Tatnuck Brook and the Cooks Pond spillway generally followed similar seasonal fluctuations. However, DO at the spillway dipped considerably lower than the inflow during September.*



✱ *Zero values represent results that were below the detection limit for TP (≤0.010 mg/l)*

Figure 16 *–* TP in Tatnuck Brook was variable, ranging between undetected and 0.286 mg/l. TP at the spillway was generally lower ranging between 0.012 and 0.045 mg/l.

Ongoing Projects

Tatnuck Brook Project. Over the course of 2022, a team of WSU students, faculty, and staff have worked on the Tatnuck Brook Project, a project funded by the WSU Aisiku Interdisciplinary STEM Research Team Initiative to answer the research question "How does urbanization impact water quality in urban reservoirs?". During the summer months, the team collected water quality data and surveyed macroinvertebrates in and around Patch Reservoir and Cooks Pond in collaboration with concurrent

sampling by the City of Worcester downstream. This work benefited from equipment and support from collaborators from the Clark University Department of Biology. During the fall, the team split in two so that water quality monitoring and data analysis could be carried out while the macroinvertebrate samples were being analyzed. Major contributors to the project included: Stephen Humphrey, Caitlin Dellert, Zachary Trudell, and Kari Mickunas. Additional students are processing the macroinvertebrates, including: Brianna Chang and Katie Steeves; and helping monitor water quality, including Emily Maynard and Alyssa Bishop. WSU faculty members Dr. Allison Dunn, Dr. Laura Reynolds, Dr. William Hansen, Dr. Meghna Dilip, Dr. Diana Sharpe, and Alyssa Hammond helped guide students and oversaw the project.

State of the Lake

In 2022, Cooks Pond received a score of "Excellent". There were no fecal bacteria exceedances of the recreational threshold all season, and the invasive aquatic plant management plan is working well, and infestations are not hindering recreational activity. Nutrient concentrations were generally low in the pond itself, and temperature results were considered "Excellent". Water clarity was a little lower than expected or desired, but the cause of this was not determined to be cyanobacteria activity.

Plan for 2023

Water Quality Monitoring

A modified version of the Tatnuck Brook Project will continue moving forward as part of the The Central Massachusetts Watershed Project, a subdivision of the WSU AIsiku STEM center. WSU students and faculty will continue to monitor several aspects of water quality in the Tatnuck watershed. WSU also plans to continue to collect litter and participate in community clean up events.

Invasive Aquatic Plant Management

In 2023 the Smith Pond Corporation will continue to visually inspect and hand pull water chestnut, and will reevaluate other invasive aquatic plants to determine if additional management is needed.

Education and Outreach

Presentations of Student Research. This project has given several opportunities for students to present their research at academic conferences. Students will present at the Massachusetts Undergraduate Research Conference in Late April, the Worcester State Celebration of Scholarship & Creativity on 26-Apr 2023 (which is open to the public), and to the Tatnuck Brook Watershed Association.

Family Aquatic Science Day. As part of the 2021 Blue Space Angler Event Series, the Tatnuck Brook Watershed Association (TBWA) hosted an event at Coes Reservoir called the Family Aquatic Science Day (*see Figure 17*). In this event participants of all ages discovered the aquatic environment through a series of booths where they took measurements with water quality meters, learned about aquatic macroinvertebrates, looked at cyanobacteria under a microscope, explored a 3-D replica of a watershed, and collected fish with a large seine net.

The Lakes and Ponds Program and WSU plans on supporting the TBWA in holding the event again in 2023 and increasing participation from local young people. This will serve as an opportunity to continue to raise awareness about factors that lead to cyanobacteria blooms and how community members can support L&P's efforts to mitigate the ecological and public health concerns they create.

Figure 17–*Attendees and volunteers at the 2021 Family Aquatic Science Day collect fish and other aquatic organisms in a seine net.*