North Sandy Pond Management Plan

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FINAL

Prepared for
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1 Introduction

North Sandy Pond is a shallow waterbody located in the Town of Sandy Creek in northern Oswego County, New York. The watershed of North Sandy Pond additionally includes southern Jefferson County (**Figure 1**). It is a natural lake within the Eastern Lake Ontario Basin, comprised of a large bay separated from Lake Ontario by a unique barrier beach system. Due to ongoing water quality concerns, including Harmful Algal Blooms (HABs), the Town of Sandy Creek and Oswego County funded the development of this Lake Management Plan to evaluate water quality, document HABs, and provide management alternatives to improve the overall condition of North Sandy Pond into the future.

This Lake Management Plan for North Sandy Pond focuses on the history of the embayment and its watershed, trends in water quality, and an evaluation of sources of nutrients based on best available information. Recommended actions include a continued focus on water quality monitoring to determine nutrient input sources and reduce external nutrient inputs, community education to implement best management practices for the overall benefit of the lake, and documenting HABs and their potential toxins during blooms to protect public health and wildlife.

An adaptive management approach is recommended for North Sandy Pond that acknowledges uncertainties and incorporates future data into management strategies as they become available.

2 Objectives and Scope

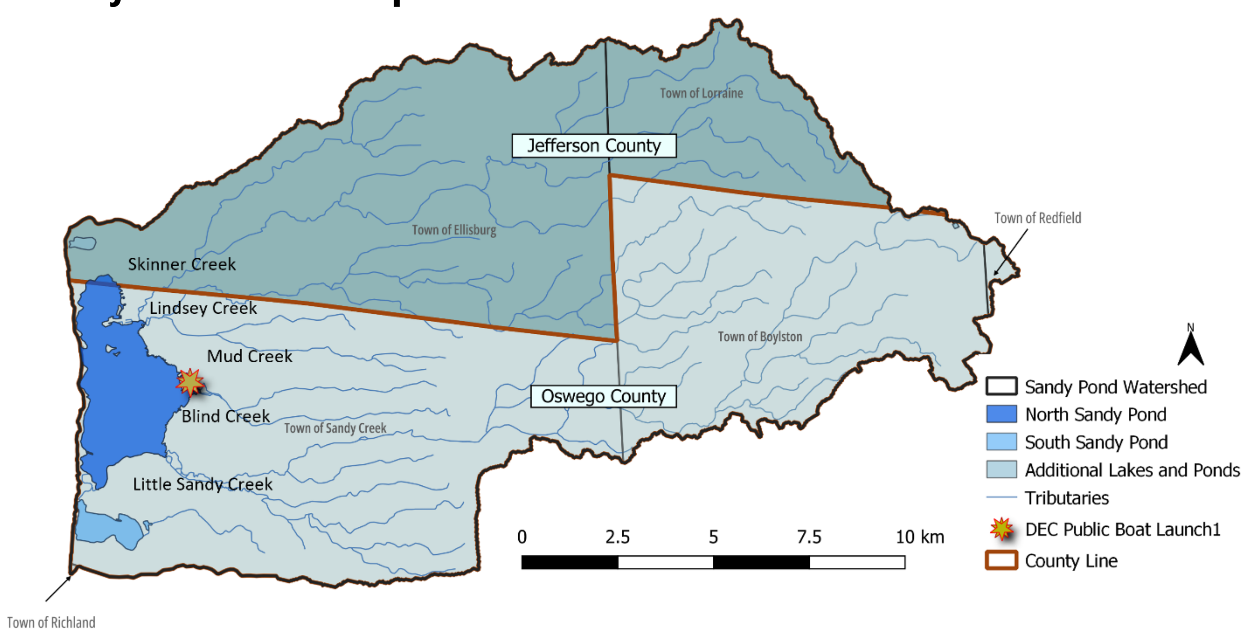

Figure 1. Overview of North Sandy Pond watershed.

Throughout the summer of 2022, as in previous years, North Sandy Pond experienced noxious cyanobacterial harmful algal blooms (CyanoHABs) that limited the recreational usage and aesthetic enjoyment of the lake. This condition has become the norm in North Sandy Pond, prompting the development of this plan to characterize the waterbody, evaluate existing data, and provide guidance for the effective management of CyanoHABs, and overall water quality, to enable continued recreational enjoyment and ecological value of North Sandy Pond.

Elevated nutrients and sediment inflows can affect habitat quality and can alter the distribution and species composition of native wildlife. Phosphorus is the primary nutrient limiting primary production (growth of photosynthetic organisms, including aquatic plants and algae) in New York State lakes. Therefore, this plan focuses on sources and strategies for limiting the amount of phosphorus entering North Sandy Pond (although nitrogen data is presented and contextualized for overall trends related to water quality).

This management plan builds upon previous efforts to evaluate the North Sandy Pond system and present recommendations, based upon the best available scientific information, to improve overall water quality conditions.

The NYSDEC 303(d) impaired waterbody list is comprised of lakes, rivers, streams, and estuaries throughout New York that exhibit water quality and/or habitat conditions that do not support their designated uses. North Sandy Pond is not currently listed in the NYS 303(d) list of impaired waters[1], however, North Sandy Pond was identified as in need of verification of impairment (NYSDEC 2016).

The 2023 North Sandy Pond Lake Management Plan focuses on the following topics:

- Waterbody and watershed history, land use, and development
- Water quality status and trends
- Likely sources of nutrients based on best available information
- Watershed and lake-based recommendations to enhance desired uses
- Recommendations for long-term monitoring to assess progress of water quality

2022-2023 Monitoring Approach

A monitoring program at North Sandy Pond was conducted in 2022 (June – September), and its major tributaries sampled in late 2022 through early 2023 (October to April). Water quality sampling at North Sandy Pond was conducted over 8 monitoring events, twice per month. Water samples were collected at two sites (**Figure 2**) – one in

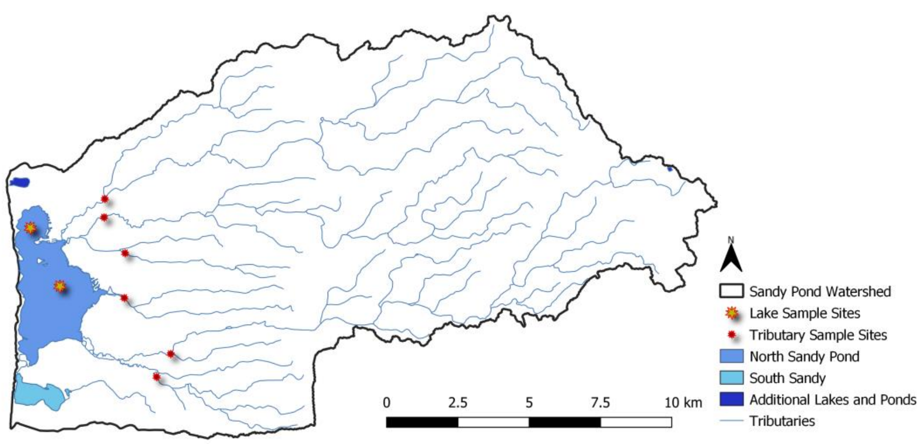

Figure 2. North Sandy Pond and tributary sampling sites in 2022-2023.

[1] *2018 Section 303(d) List of Impaired Waters Requiring a TMDL/Other Strategy* – available at https://www.dec.ny.gov/docs/water_pdf/section303d2018.pdf.

the main basin (SAND1) and one in the northern basin (SAND2). Surface water samples were collected (~ 0.2 m, or 6 inches) below the surface at each site during each event, and analyzed by UFI's ELAP certified laboratory for the following parameters:

- Total phosphorus (TP)
- Total dissolved phosphorus (TDP)
- Total nitrogen (TN)
- Nitrate + Nitrite (NOx)
- Ammonia (tNH3)
- Chlorophyll-a (Chl-a)
- FluoroProbe (bbe Moldaenke) assessment of phytoplankton, plus microscopy
- Total microcystin toxin concentrations on select samples

A multiprobe profile of the water column was collected at site SAND1 to measure water temperature (°C), pH, specific conductance (µS/cm), turbidity (NTU), and dissolved oxygen (mg/L, % saturation) at 0.5 m depth intervals. Visual observations were made at North Sandy Pond during each monitoring event to document the presence of CyanoHABs, which included visiting shoreline areas where suspected blooms may be present, and collecting surface scum samples if CyanoHABs were observed. CyanoHAB samples were evaluated for phytoplankton community structure (FluoroProbe), cyanobacteria taxa (microscopy), and if deemed appropriate, microcystin toxin concentrations (ELISA).

Tributary sampling occurred at six locations on the main tributaries draining to North Sandy Pond, including Skinner Creek, Lindsey Creek, Mud Creek, Blind Creek, and Little Sandy Creek (two sites) (**Figure 2**). Water quality parameters measured at each location during the six sampling events included:

- TP
- TDP
- Soluble reactive phosphorus (SRP)
- TN
- Nox
- tNH3
- Total suspended solids (TSS)

Additionally, estimates of stream flow were collected and multiprobe measurements of temperature (°C), pH, specific conductance (µS/cm), turbidity (NTU), and dissolved oxygen (mg/L, % saturation) were recorded during each sampling event.

The data collected on North Sandy Pond in 2022, and its tributaries from 2022-2023, were used in addition to existing historical water quality data to meet the objectives of this management plan described above.

3 Cultural and Environmental Setting

3.1 North Sandy Pond and Watershed

Given the abundance of natural resources, including proximity to Lake Ontario, the Tug Hill Plateau, and numerous streams, it is no surprise that the Town of Sandy Creek became a focal point of settlement in the region. Prior to the settlement of Europeans in the early 1800's, the land was utilized by members of the Haudenosaunee Confederacy for hunting and fishing. In 1803 the first European family settled in what is now known as the Village of Lacona, sparking further settlement and development of the area including the establishment of a tavern, store, sawmill, and schoolhouse all before 1812[2].

During the war of 1812, North Sandy Pond, then known as Wigwam Cove, was an important waterbody as it had connections to Lake Ontario and the St. Lawrence River making it an ideal place to locate troops and military equipment. Following the end of the war, settlement and development resumed growth and in 1825 the boundaries were set declaring the Town of Sandy Pond.

Like much of the Upstate New York region at the time, dairy became a staple product of production. The town earned the title "Home of the big cheese" in 1835 after Colonel Thomas Meacham produced a 1,400-pound wheel of cheese that was gifted to President Andrew Jackson. By the late 1800s increased interest in the area spurred the development of a schoolhouse, post office, general store, and bank amongst others.

North Sandy Pond is separated from Lake Ontario by a portion of the Eastern Lake Ontario Dune and Wetland area, which extends 17 miles along Lake Ontario. The Lake Ontario sand dunes are a valuable resource to people and the environment providing protection of the shore against erosion, element protection from lake winds enhancing recreation on the pond, and even habitat for a diverse range of species including the piping plover which are endangered to the Great Lake region.

North Sandy Pond is a small, eutrophic waterbody with a surface area of 9.7 km^2 (2,400 acres), located in the Town of Sandy Creek (Oswego County). Water flows into North Sandy Pond from numerous tributaries, including (north to south) Skinner Creek, Lindsey Creek/Mud Creek, Blind Creek, Little Sandy Creek, and South Sandy Pond. The outlet of the lake

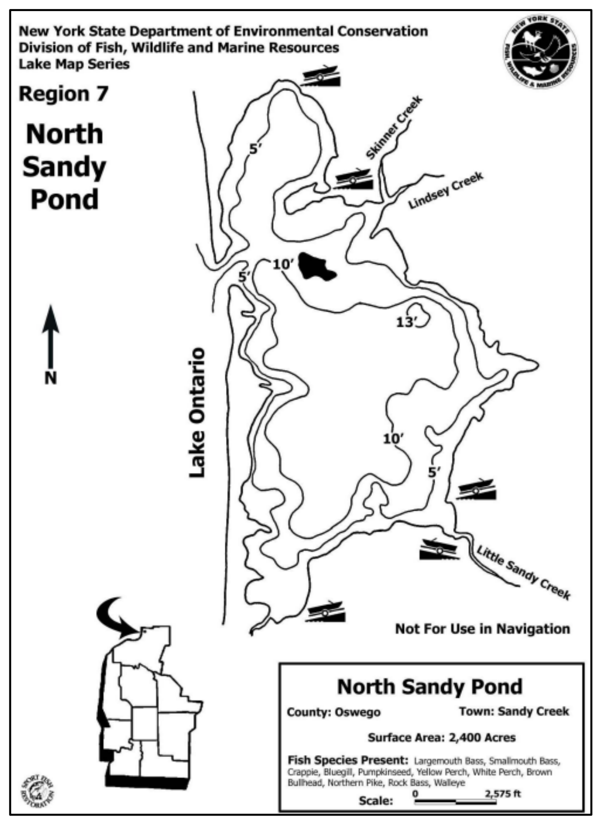

Figure 3. Bathymetric map of North Sandy Pond (Source: NYSDEC).

[2] Information from *Comprehensive Plan – Town of Sandy Creek, Village of Sandy Creek, and Village of Lacona*. September 2013, available at https://www.cnyrpdb.org/sccp/docs/CompPlan/Draft_Sandy_Creek_Comp_Plan_JG_9_12_13.pdf.

is to Lake Ontario through an ecologically unique barrier dune complex.

North Sandy Pond is shallow, with a maximum depth of 4.0 meters (13 ft.) (**Figure 3**).

3.2 Land Use and Development Patterns

Land cover characteristics can significantly impact water quality management practices due to their influences on the delivery of water, nutrients, and sediment from the watershed to the lake. A lake with a mostly forested watershed will generally have lower levels of nutrient loading compared to a lake dominated by intensive agricultural and/or developed land cover types. North Sandy Pond is in a rural portion of New York State where agriculture and forested land play important roles in the local economy. The watershed reflects this, containing a large amount of forested land, with only a moderate amount of agricultural land, primarily used for cultivated crops and pastures (**Figure 4**). There are locations within the North Sandy Pond watershed that are populated, including the villages of Sandy Creek and Lacona – population for these villages was approximately 650 individuals according census data from 2021. These villages rely on septic systems and are in proximity to Little Sandy Creek that flows into North Sandy Pond.

There are five main tributaries that flow into North Sandy Pond, including Skinner Creek, Lindsey Creek, Mud Creek, Blind Creek, and Little Sandy Creek. The number and size of tributaries draining to North Sandy Pond, and the watershed size relative to the surface area of the lake, suggests that loading from the watershed may be an important driver of water quality, especially during high flow periods.

Land cover at the watershed scale over an 18-year period (2001 to 2019) has remained largely stable over the past two decades (**Figure 5**), with a few patterns of note. Over this period, there has been a reduction in agricultural land and forests, with an increase in moderately intensive development and grasslands (perhaps suggesting a conversion of active agricultural land to fallow properties). Forests remain the dominant land cover type in the watershed at approximately 60% of the total area (**Figure 4**). Wetlands in the North Sandy Pond watershed are notable due to their ecological and water quality importance. Wetland areas can act as sediment and nutrient sinks during the growing season, but also can contribute naturally to lake nutrient levels during periods of decomposition of organic matter. The primary wetland areas within the North Sandy Pond watershed are found to the north (*e.g.,* Lakeview Wildlife Management Area) and near the inlets of the main tributaries (**Figure 4**).

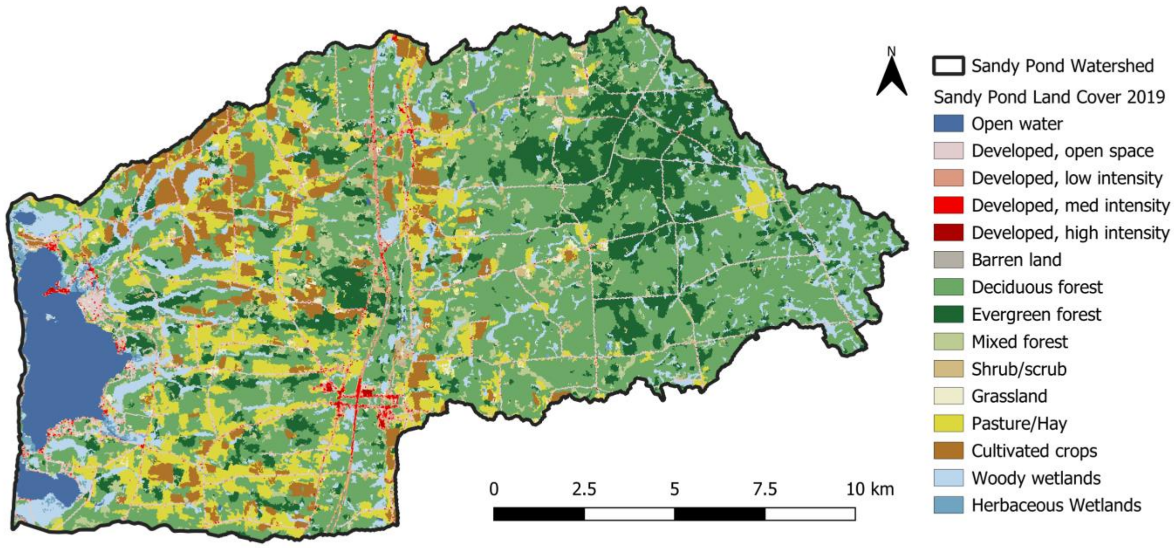

Figure 4. Land cover of the North Sandy Pond watershed (Source: National Land Cover Database (NLCD), 2019).

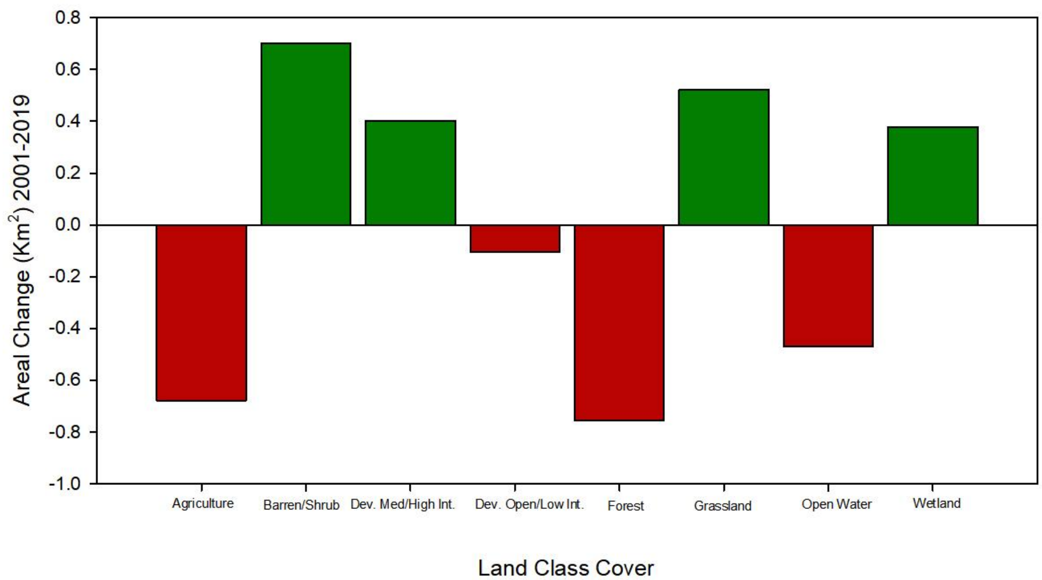

Figure 5. Change in land cover categories for the North Sandy Pond watershed from 2001 to 2019 (Source: NLCD).

4 North Sandy Pond Water Quality Status and Trends

4.1 Regulatory Classification and Best Use

Best use classifications for surface waters, which are developed by the NYSDEC Water Quality Standards Program, establish regulatory expectations for lake water quality and ecosystem health. Class A and AA waters are waterbodies classified as suitable for drinking and culinary purposes, as well as primary and secondary contact recreation and fishing. The best usages of Class B waters are primary and secondary contact recreation and fishing. Class C waters are best used for fishing and should be suitable for primary and secondary contact recreation, although other factors may limit the use for these purposes. The best use of Class D waters is fishing. The NYSDEC will routinely review the water quality and habitat data to determine whether the lake still supports its designated best use.

North Sandy Pond is classified as a Class B waterbody; however, in recent years the increase in documented CyanoHABs and excess plant growth within the pond has limited opportunities for primary recreation.

4.2 Limnological Characteristics and Trophic State

4.2.1 Physical Characteristics and Stratification Regime

North Sandy Pond is a shallow water body that does not seasonally stratify during the warm season, meaning the water column is largely mixed top to bottom throughout an annual period. Being shallow, wind-induced turbulence is sufficient to mix the shallow lake. During periods of increased air temperature and low wind conditions, intermittent stratification may occur in North Sandy Pond between the upper and lower waters; however, wind-induced mixing disrupts short periods of thermal stratification. It is unclear if stratification occurs during the cold winter months when ice cover is present on North Sandy Pond, which may result in inverse thermal stratification with the coldest water at the surface and slightly warmer water of approximately 4°C near the bottom. Water column profiles of temperature in North Sandy Pond from 2022 show very slight vertical gradients in water temperature (**Figure 6**). Additionally, the thermal structure of the lake, created using the profile data and extrapolating between sampling dates, further suggests limited stratification of North Sandy Pond during the summer of 2022 (**Figure 7**).

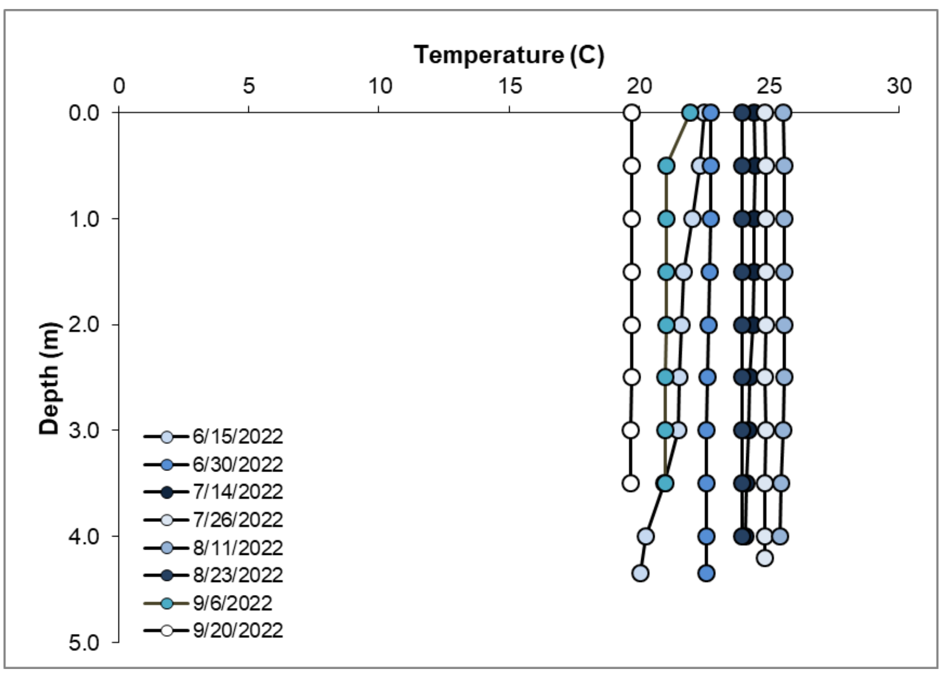

Figure 6. Water temperature (°C) profiles of North Sandy Pond from the SAND1 sampling site (43.6567, -76.1774) from June through September 2022.

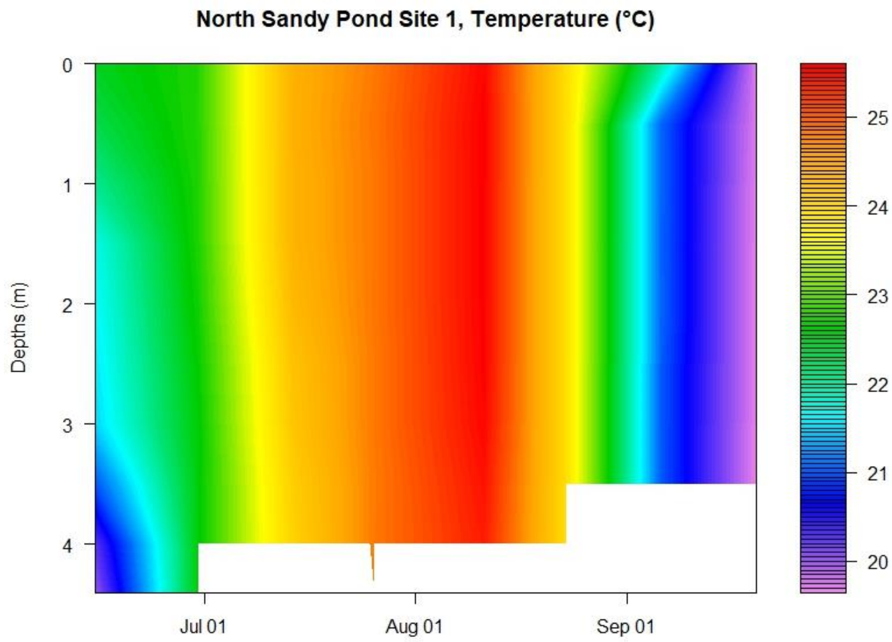

Figure 7. Water temperature in North Sandy Pond from June through September interpolated based on temperature profiles collected by UFI with a YSI 6600 multi-parameter sonde.

North Sandy Pond experienced surface water temperatures of around 22°C (~ 72°F) in early June, followed by warming to above 25°C (77°F) in August, cooling back to the low of 19.7°C (67°F) in late September (**Figure 6**).

Temperature is a primary regulator of important physical, chemical, and biochemical processes in lakes and is perhaps the most fundamental parameter in lake monitoring programs. Lakes in the northeast exhibit major temperature transformations linked to annual changes in air temperature and incident light. Biochemical processes and the life cycles of aquatic organisms are linked to the annual temperature cycle.

In a lake that is periodically mixing and distributing nutrients and temperature throughout, the changes in atmospheric temperature can influence lake quality in fundamental ways. For example, lakes that stratify can experience a decline in dissolved oxygen at depth due to a lack of water column mixing, reducing available aquatic habitat, organismal growth rates, and a potential increase in CyanoHABs from increased nutrient release from the sediment. In North Sandy Pond, the lack of thermal stratification allows dissolved oxygen to be continually replenished at depth (**Figures 8** and **9**).

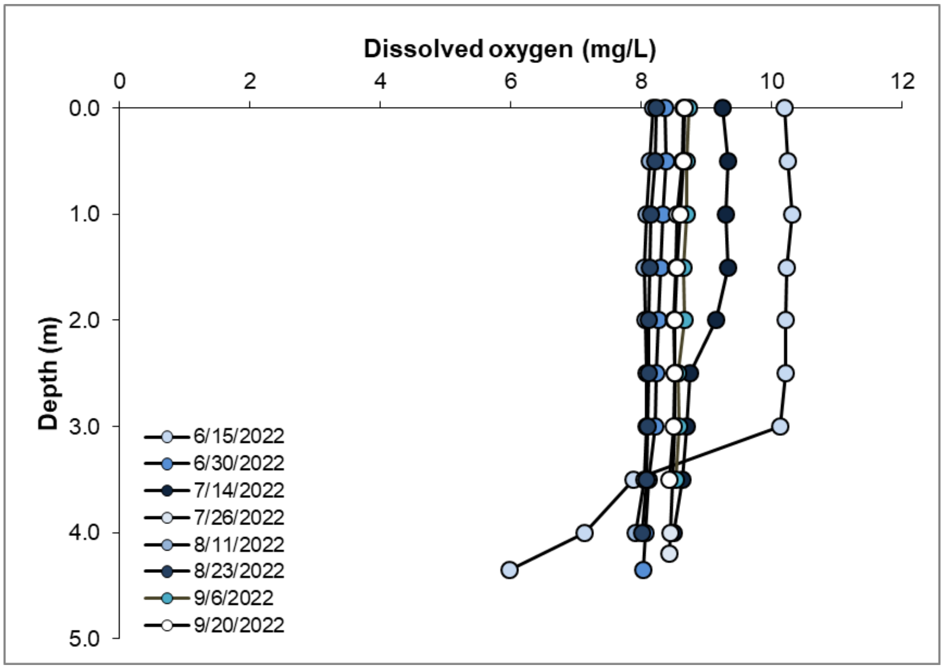

Figure 8. Dissolved oxygen (DO, mg/L) profiles of North Sandy Pond from the SAND1 sampling site (43.6567, -76.1774) from June through September 2022.

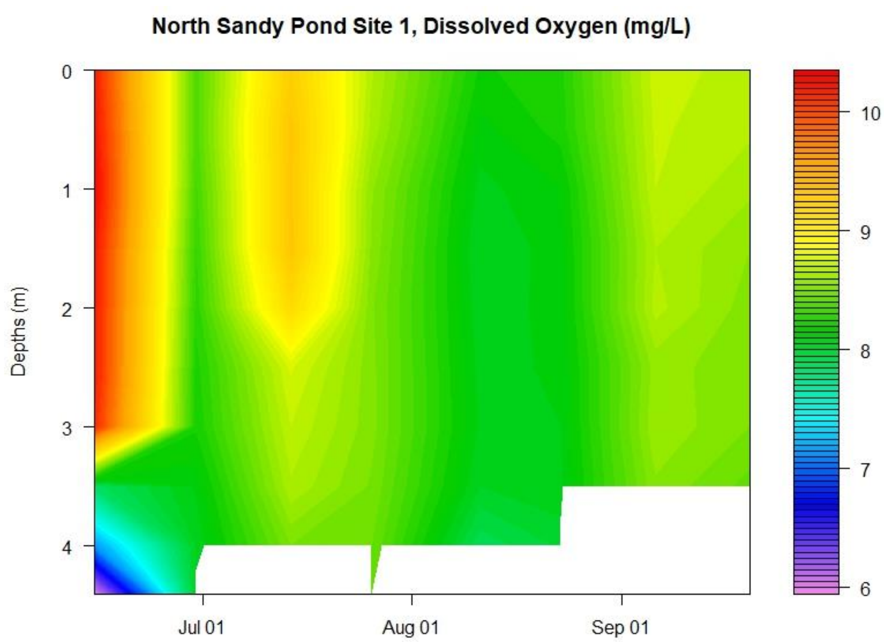

Figure 9. Dissolved oxygen (mg/L) in North Sandy Pond from June through September interpolated based on temperature profiles collected by UFI with a YSI 6600 multi-parameter sonde.

4.2.2 Lake Condition and Water Chemistry

4.2.2.1 Phosphorus and Nitrogen

Phosphorus (P) is recognized as the most critical nutrient controlling phytoplankton (microscopic plants and cyanobacteria present in open waters) abundance in most freshwater systems in the north temperature zone, as the increase in the availability of P often leads to an increase in phytoplankton productivity (as the main limiting nutrient for growth). Occurrences of particularly high phytoplankton concentrations are described as blooms, and high concentrations of scum-forming cyanobacteria are termed cyanobacteria harmful algal blooms (CyanoHABs). Anthropogenic activity can be responsible for the increase in P entering water systems, described as cultural eutrophication. The decrease in P availability and inputs into lakes is a documented restoration strategy to abate eutrophication and minimize the negative impacts from CyanoHABs. P is commonly measured in three forms during lake monitoring: TP, TDP, and SRP.

TP is widely used to indicate trophic state (or the measure of a lakes nutrient concentrations and productivity). TDP and SRP are measured on filtered (0.45 µm) samples. Most TDP is assumed to be available to support phytoplankton growth. SRP is a component of TDP that is assumed to be immediately available to support phytoplankton growth. New York State has established a guidance value for TP of 20 µg/L (growing season average) to protect contact recreation in Class B and higher lakes.

During the 2022 North Sandy Pond monitoring program, concentrations of TP averaged 48.0 µg/L (+/- 20.6) at site SAND1. The minimum TP concentration measured was 16.6 µg/L on June 15th and the maximum concentration was 72.2 µg/L from September 20th. Concentrations of TP at SAND1 steadily increased over the sampling period in 2022 (**Figure 10**). Total dissolved phosphorus concentrations similarly increased at SAND1 over the sampling period from June through September (**Figure 10**).

The average TP concentration at SAND2 was 49.5 µg/L (+/- 14.2), with a minimum concentration of 23.1 µg/L measured on June 15th and a maximum concentration of 63.6 µg/L measured in early September. Like site SAND1, concentrations of TP and TDP increased during the monitoring period in 2022 (**Figure 10**).

Concentrations of P in 2022 suggest that North Sandy Pond is in a eutrophic state (TP concentrations >30 µg/L), reflective of high nutrient concentrations and high algal productivity. The majority of P measured in North Sandy Pond in 2022 was TP, indicating that much of the phosphorus in the water column is bound in algal cells.

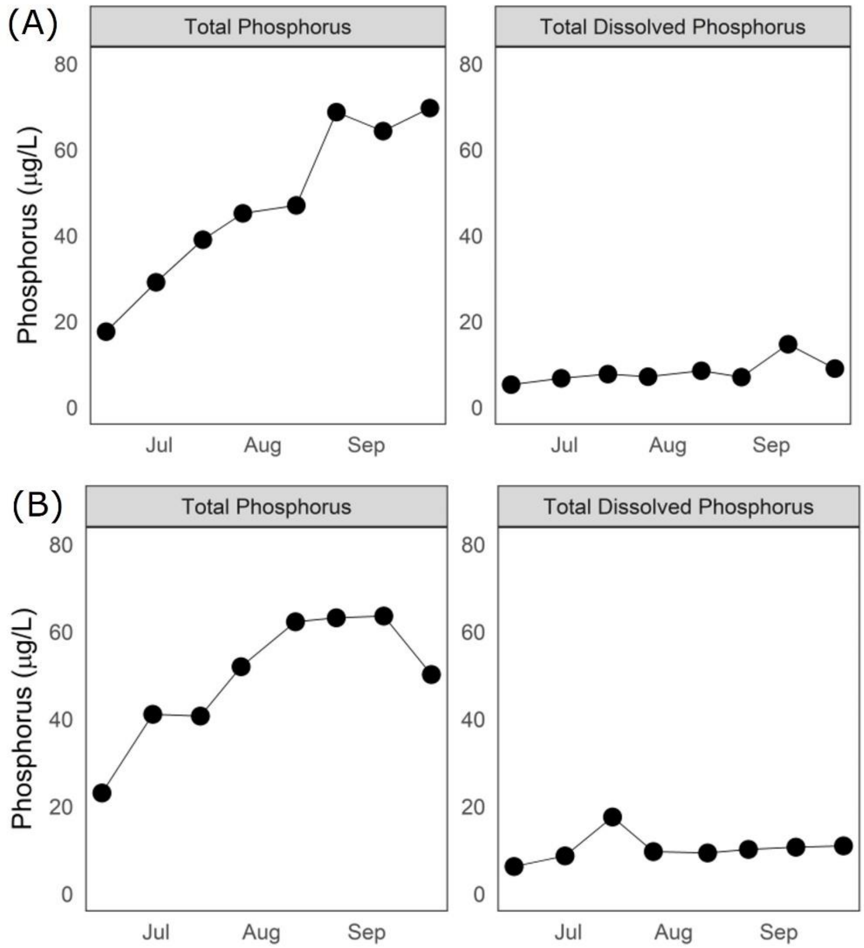

Figure 10. Total phosphorus (µg/L) and total dissolved phosphorus (µg/L) from 2022 water monitoring in North Sandy Pond at (A) SAND1 and (B) SAND2.

Nitrogen (N) is another important macronutrient in freshwater systems that can affect algal biomass and the composition of algal communities. It is likely the second most critical nutrient controlling phytoplankton growth and can become the limiting nutrient seasonally in some lakes. Excess nitrogen can lead to the overgrowth of aquatic plants and algae. Two common usable forms of nitrogen for aquatic primary producers (algae and plants) include nitrate (NO_3^-) and ammonium ions (NH_4^+). Lake monitoring programs typically measure N as total N (TN), total ammonia (T-NH3), and total oxidized N (NOx). Two components contribute to Nox, nitrate (NO_3^-) and nitrite (NO_2^-). The dominant component, by far, is NO_3^- as NO_2^- is almost always present in low concentrations due to its highly reactive nature.

In 2022, concentrations of TN averaged 841 µg/L (+/- 377) at SAND1 and increased from 256 µg/L to 1335 µg/L over the June-September interval (**Figure 11**). Concentrations of TN increased at SAND1 in 2022 (**Figure 11**). The average concentration of TN at SAND2 was 745 µg/L (+/- 326), similarly increasing through the monitoring period (**Figure 11**). Much of the nitrogen pool in North Sandy Pond is organic in nature (proteins, nucleic acids, other organic compounds in plants, animals, and/or microbial biomass). Like P, concentrations of TN indicate eutrophic, or highly productive, conditions (generally, TN concentrations >650 µg/L). Concentrations of nitrate+nitrite and total ammonia were generally low and near the analytical limits of detection. These bioavailable forms of N are rapidly incorporated into algae and other biota.

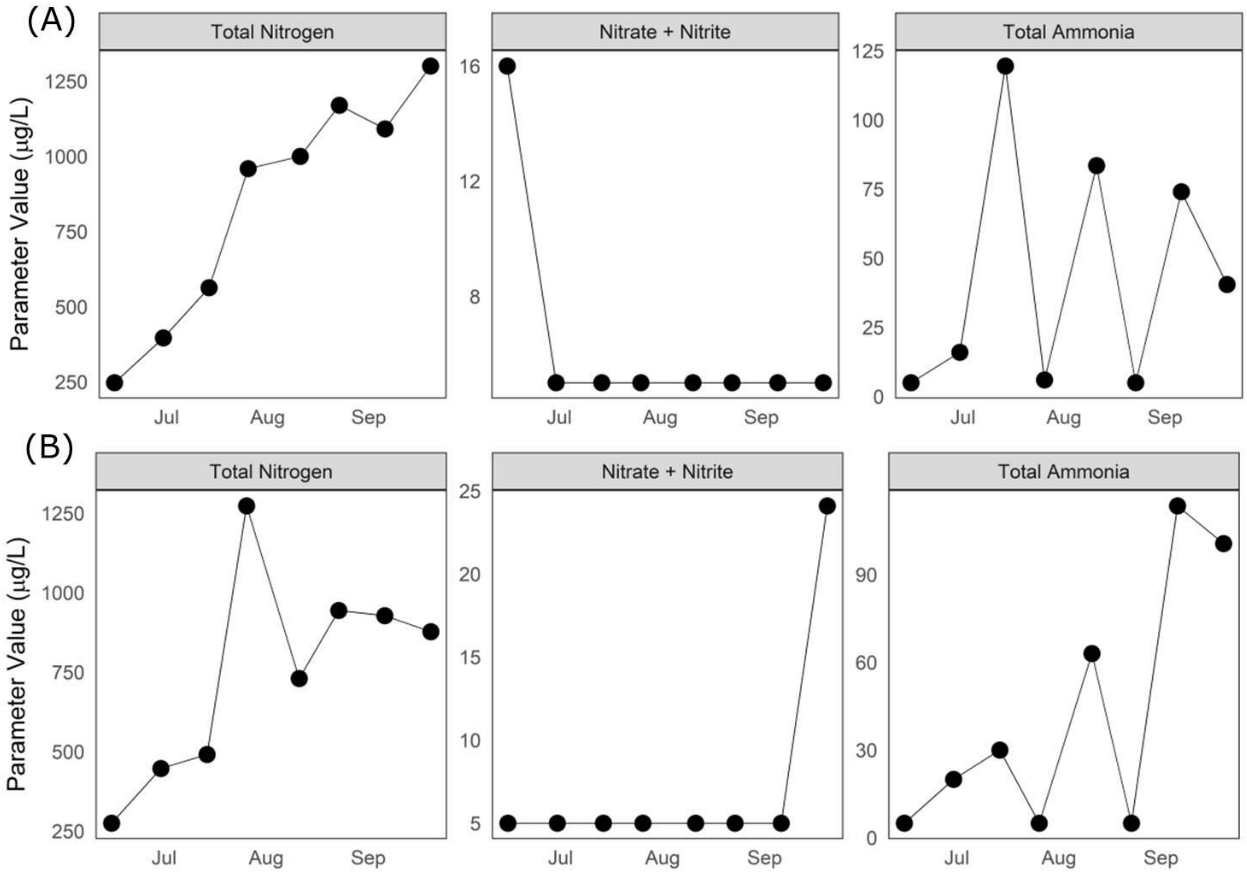

Figure 11. Total nitrogen (µg/L), Nox (Nitrate+Nitrite, µg/L), and total ammonia (µg/L) from 2022 water monitoring in North Sandy Pond at (A) SAND1 and (B) SAND2.

4.2.2.2 Algal Biomass

Algae contain multiple photosynthetic pigments that serve a variety of photochemical functions. Chlorophyll-a (Chl-a) is the primary photosynthetic pigment and the only pigment common to all algae and cyanobacteria. Due to its universal presence, Chl-a is the most widely used proxy for phytoplankton biomass. Various environmental conditions that can affect Chl-a concentrations include light exposure, temperature, and nutrient availability. Additionally, measurements of Chl-a do not resolve phytoplankton type, and the Chl-a content per unit biomass can vary according to species. Therefore, Chl-a is a preferred, albeit imperfect, measure of phytoplankton biomass.

During the 2022 monitoring season, average Chl-a concentrations were 58.1 µg/L (+/- 43.8) at SAND1, and 31.1 µg/L (+/- 18.0) at SAND2. Chl-a concentrations were generally greater at the sampling location in the middle of the North Sandy Pond (SAND1) compared to the sampling location in northern basin (SAND2) (**Figure 12**). The concentrations of Chl-a measured in 2022 suggest an elevated level of phytoplankton biomass and eutrophic conditions. Wide temporal variations in Chl-a concentrations are common in productive lakes such as North Sandy Pond.

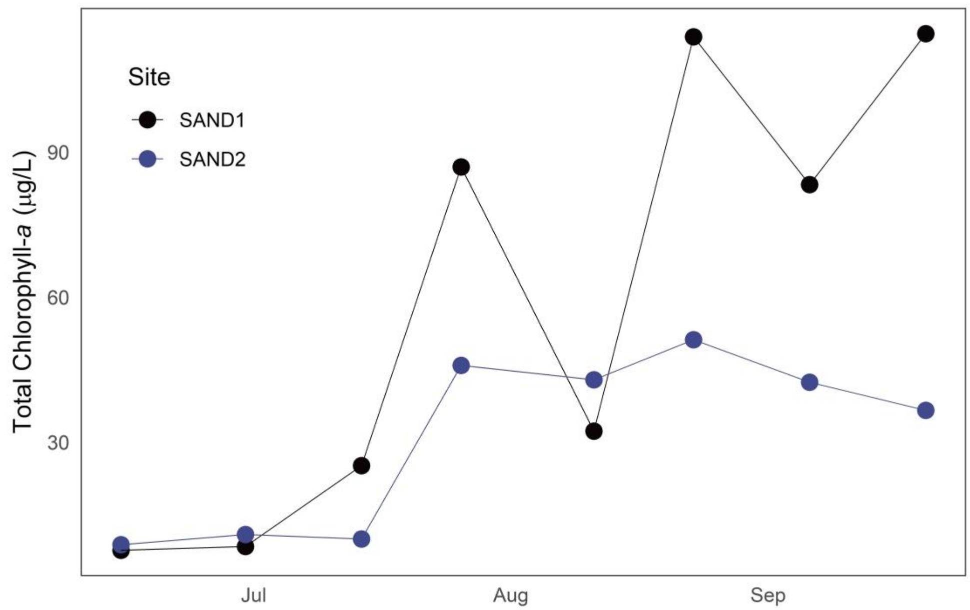

Figure 12. Total chlorophyll-a (µg/L) during 2022 monitoring of North Sandy Pond at sites SAND1 and SAND2.

A FluoroProbe (bbe Moldaenke) is an instrument that measures fluorescence of phytoplankton, providing information about the concentration and composition of different phytoplankton groups in a sample. All phytoplankton (including cyanobacteria) contain chlorophyll-a, which fluoresces when excited by certain wavelengths of light. Additionally, distinct groups of phytoplankton (blue-green algae, cryptophytes, diatoms, and green algae) have different accessory photosynthetic pigments in addition to chlorophyll-a – accessory pigments have unique fluorescence characteristics and can thus be differentiated in a sample.

Based on total chlorophyll-a concentrations measured by FluoroProbe in 2022 at sites SAND1 and SAND2, North Sandy Pond was highly productive (**Figure 13**). Of note, the composition of the phytoplankton assemblage indicates that much of the phytoplankton measured in 2022 were comprised of cyanobacteria, particularly from July through September (**Figure 13**).

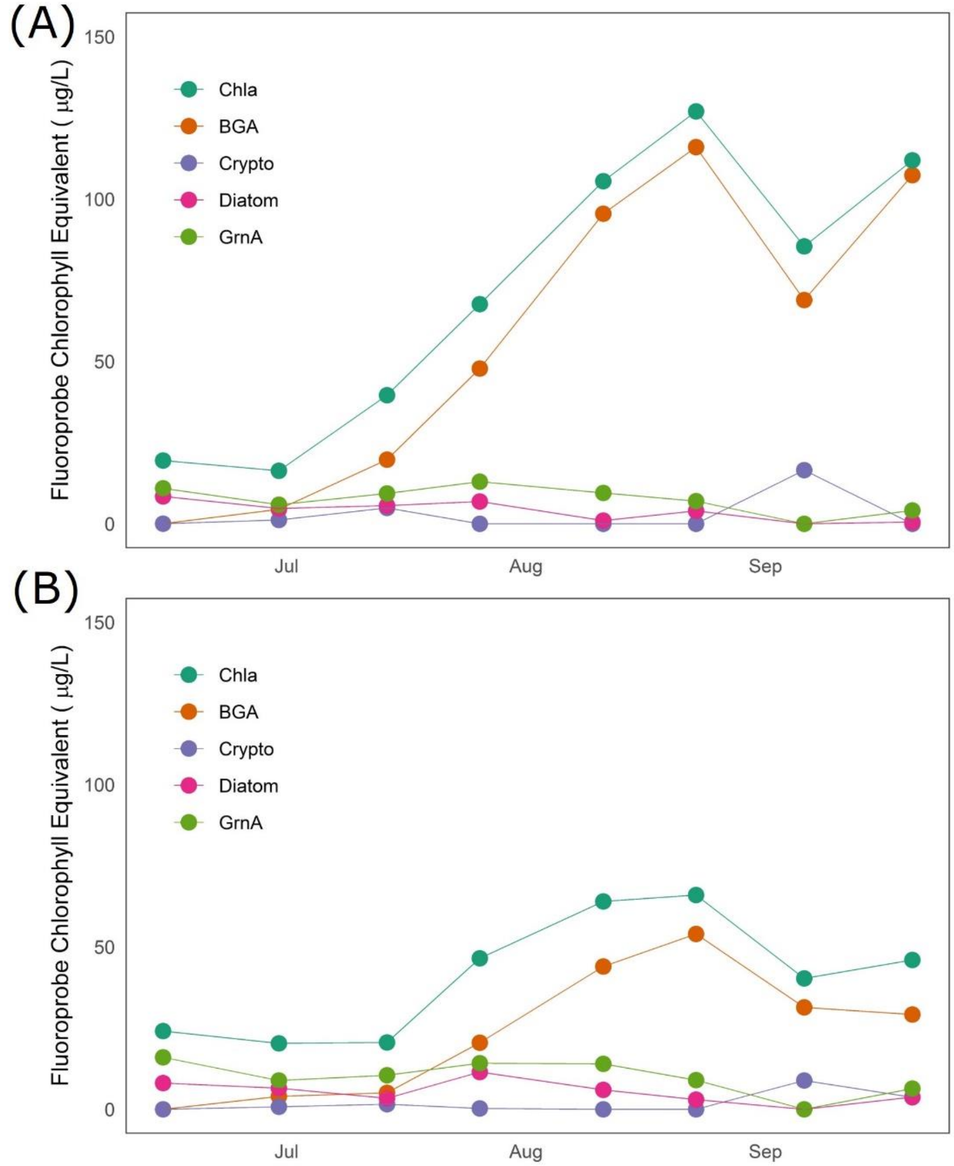

Figure 13. FluoroProbe results (µg/L) during the 2022 monitoring of North Sandy Pond at sites (A) SAND1 and (B) SAND2.

4.2.2.3 Water Clarity

Water clarity, or the extent of light penetration in water (*e.g.*, ability to see submerged objects), is coupled with public perception of water quality. The evaluation of water clarity is often measuring using a Secchi disk, a weighted white and black plate that is lowered until out of view and then raised until it is visible again. The average depth of where the disk disappears and reappears is the "Secchi depth," a proxy for water clarity. With increased suspended particles in the water, such as phytoplankton, silt, clay, or organic materials, the light transmitted will be reduced and the Secchi depth will be shallower. Secchi disk transparency remains the most used measure of light penetration. The recommended minimum Secchi depth for recreational swimming is 1.2 meters (4 ft.).

The average Secchi depth measured in North Sandy Pond during the 2022 monitoring season was 1.0 meters (+/- 0.7) at site SAND1 and 1.1 meters (+/- 0.5) at SAND2. Secchi depth decreased through the monitoring period (from ~ 2 meters in early June to < 1 meter in September), suggesting a decrease in light penetration and thus water clarity at both sites (**Figure 14**). Greater Secchi depth measurements are generally associated with lower Chl-a concentrations, while lower transparency generally coincides with increased Chl-a levels.

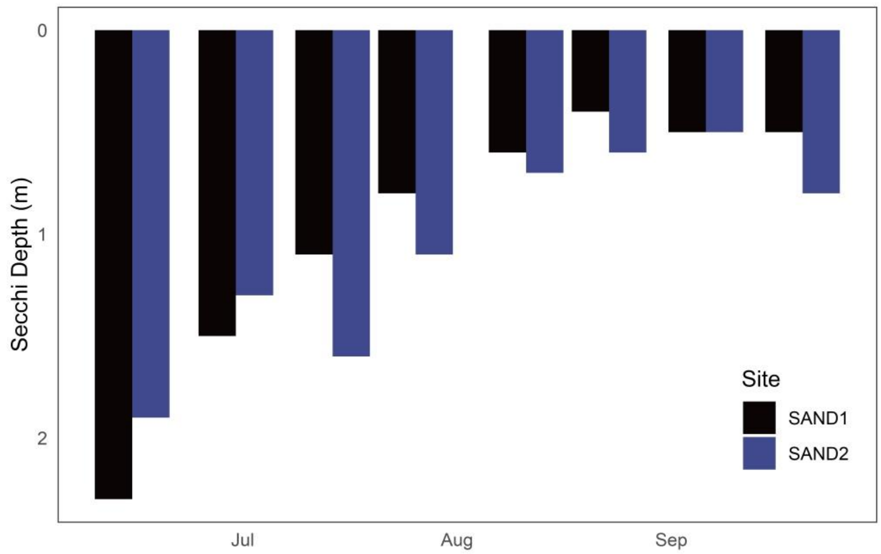

Figure 14. Secchi depth measurements (in meters) at sites SAND1 and SAND2 in 2022.

In North Sandy Pond, the relationship between Secchi depth and Chl-a is well-defined – decreased Secchi depth measurements were associated with higher concentrations of Chl-a (**Figure 15**). In other words, concentrations of chlorophyll-a explained approximately 80% of the variation in Secchi depth, suggesting algal biomass as a key determinant of water clarity in North Sandy Pond.

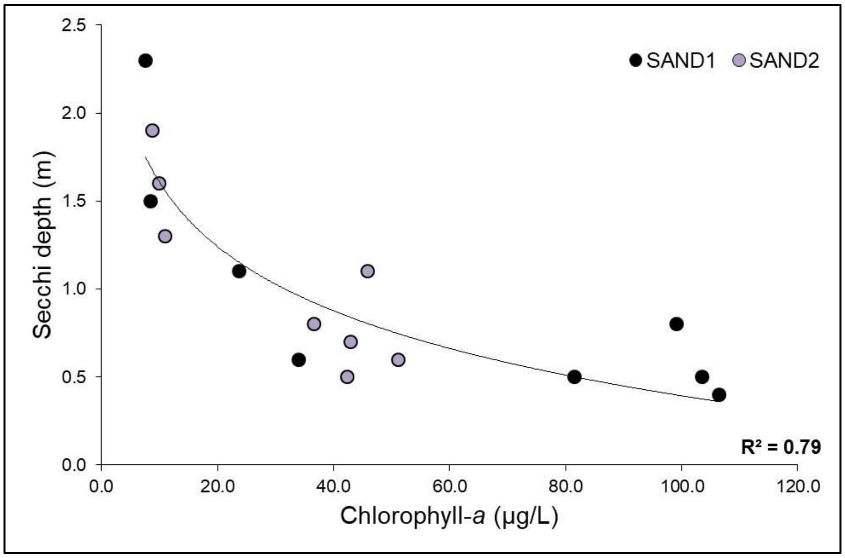

Figure 15. Relation between chlorophyll-a (µg/L) and Secchi depth (meters) in North Sandy Pond in 2022 at sites SAND1 and SAND2.

4.2.2.4 Other Water Quality Parameters

Other critical indicators of lake water quality and aquatic habitat include pH and specific conductance (SC). pH relates to the acidity or alkalinity of a solution on a logarithmic scale, which is a direct measure of the concentration of hydrogen ions [H^+] in the water. A lower pH indicates a higher concentration of hydrogen ions (more acidic), whereas a higher pH is indicative of a lower concentration of hydrogen ions (more alkaline). pH can directly and indirectly impact various biological and chemical processes within a lake ecosystem. A range of pH from 6-9 is utilized by NYSDEC to indicate that freshwater systems are meeting their designated use(s).

pH profiles of the water column at site SAND1 from June through September indicated a general uniform pH profile from the surface to a depth of around 4 meters (**Figure 16**). pH in the surface waters was around 8 through the monitoring period, suggesting a slightly alkaline condition.

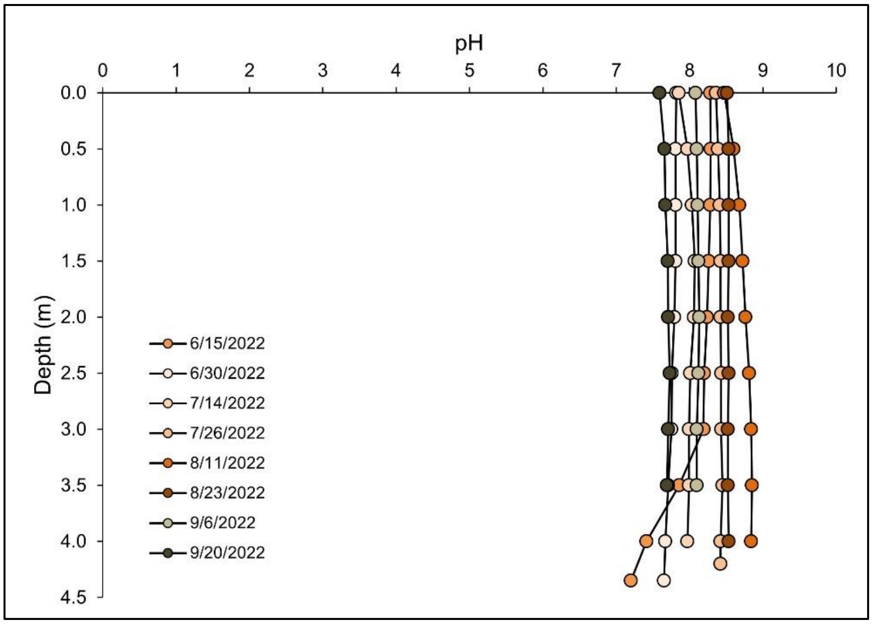

Figure 16. pH profiles of North Sandy Pond from the SAND1 sampling site (43.6567, -76.1774) from June through September 2022.

Specific conductance is an aggregate measure of the summed ionic content of water and is closely related to salinity. Measurements of specific conductance in 2022 were generally uniform and values were moderate throughout the sampling period and with depth (**Figure 17**).

Measurements of pH and specific conductivity values in 2022 do not suggest potential negative impacts to aquatic life and are within the range expected for freshwater lakes.

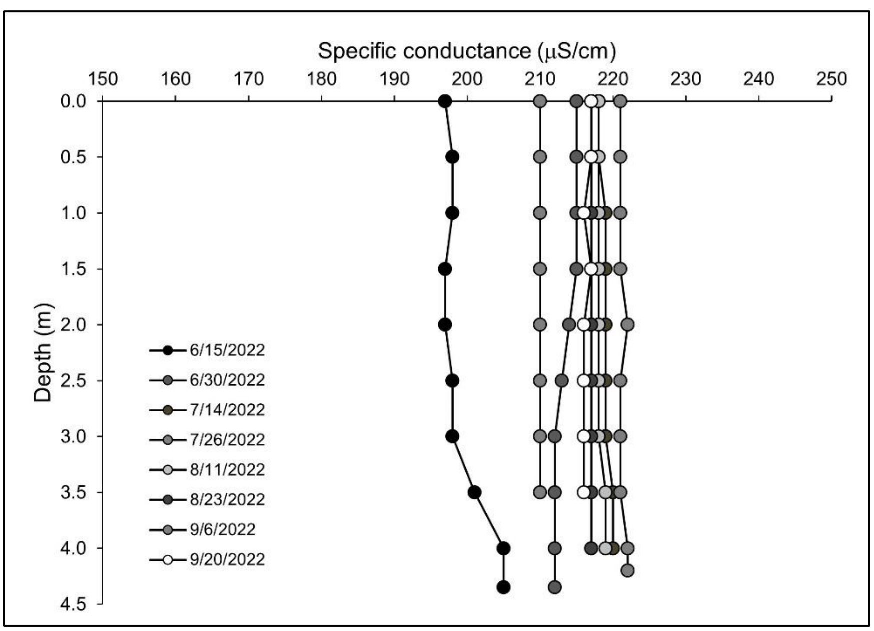

Figure 17. Specific conductance (μS/cm) profiles of North Sandy Pond from the SAND1 sampling site (43.6567, -76.1774) from June through September 2022.

4.3 Long-Term Water Quality Trends

Long-term data are essential for assessing water quality patterns and changes, and to effectively evaluate different lake management alternatives to improve water quality. There is limited long-term water quality data for North Sandy Pond. NYSDEC has intermittently collected water quality data since 1986. The historic data that is available can be characterized as occurring during the growing season (*i.e.*, June through September) and often during one day per month when sampled.

Trophic state indicators, primarily TP, Chl-a, and Secchi depth, are metrics that are used to document lake productivity and evaluate water quality trends in freshwater lakes. Long-term annual average TP values indicate that North Sandy Pond has had elevated concentrations of TP dating back to the late 1980s, based on available data (**Figure 18**). Annual average TP concentrations have been consistently greater than the NYS guidance value of 20 ug/L TP.

Similarly, long-term annual average Chl-a concentrations indicate that North Sandy Pond has had elevated concentrations of algae since the late 1980s (**Figure 19**. Secchi depth, a measure of water clarity, can additionally be used as a metric to identify waterbodies that are safe for swimming. Long-term annual average recordings of Secchi depth indicate that, in most years, average Secchi depth is at or lower than the recommended safe swimming threshold of 1.2 meters (4 feet) (**Figure 20**).

Based on the existing, long-term water quality data that is available for North Sandy Pond, the lake has been highly productive (eutrophic) for decades with no discernable pattern in water quality degradation or improvement. However, given the available long-term record suggesting high nutrient concentrations since the late 1980s, stakeholders have indicated an increase in algae in the pond in recent years. Additional stressors such as climate change or the impacts from invasive species such as zebra mussels may be contributing to an increase abundance and dominance of CyanoHABs.

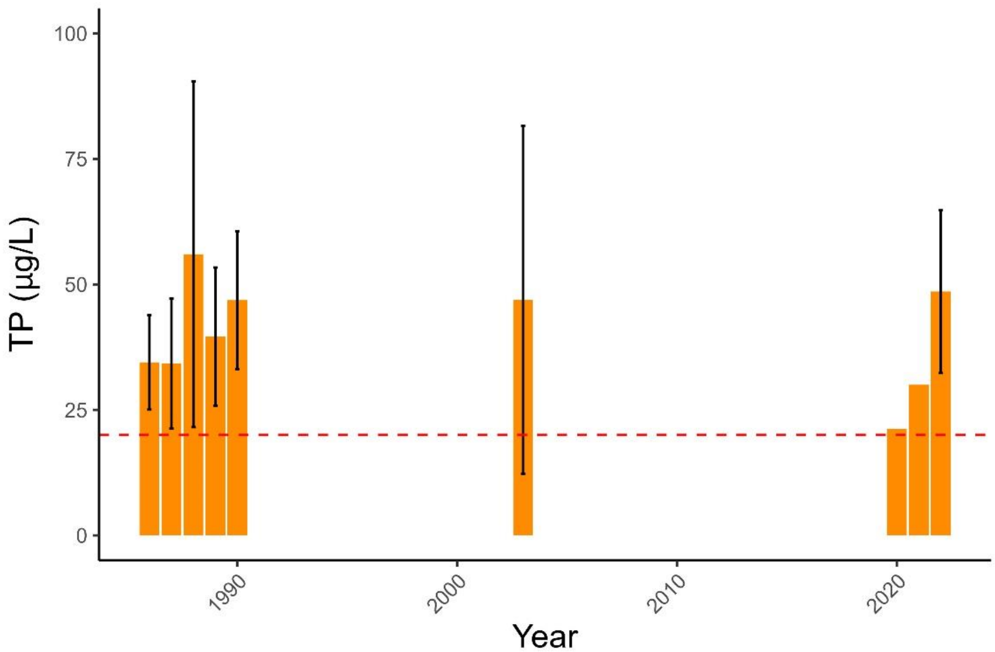

Figure 18. Long-term annual average concentrations of total phosphorus (TP) (+/- standard deviation) in North Sandy Pond. The red line represents the NYS guidance value of 20 ug/L TP.

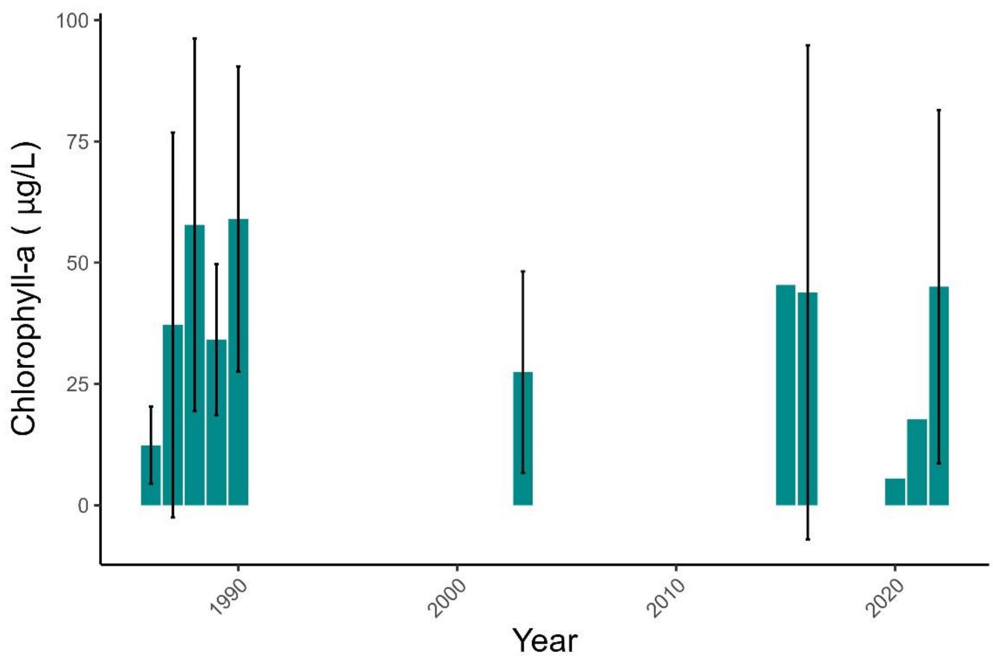

Figure 19. Long-term annual average concentrations of chlorophyll-a (+/- standard deviation) in North Sandy Pond.

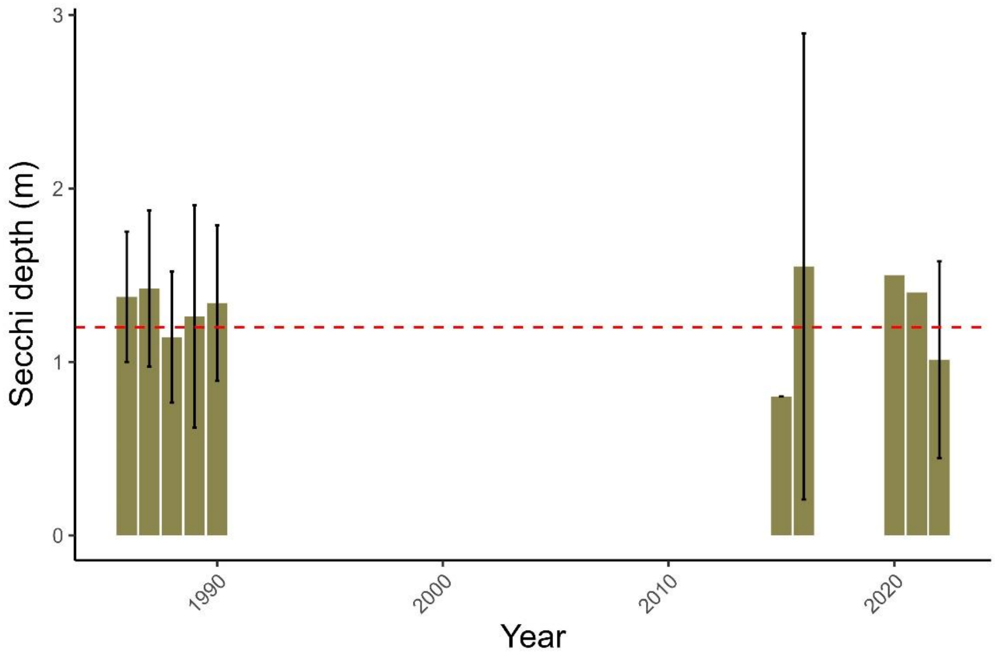

Figure 20. Long-term annual average Secchi depth (+/- standard deviation) in North Sandy Pond. The red line represents the recommended minimum Secchi depth for swimming safety (1.2 meters, 4 feet).

4.4 Emerging Issues

4.4.1 Cyanobacterial Blooms

Cyanobacterial harmful algal blooms (CyanoHABs) are characterized as the rapid growth or accumulation of cyanobacteria (*i.e.*, blue-green algae) that can cause harm to people, animals, or the local ecology. Cyanobacteria are capable of producing toxins and surface scums, both of which can impact aquatic life, pose a risk to human health, and impact recreation. In terms of public health, CyanoHABs may cause serious health complications such as a rash, eye irritation, respiratory symptoms and in severe cases, serious illness. It is also important to recognize that exposure to CyanoHAB toxins can cause mortality in animals including pets, livestock, and wildlife.

Figure 21. Shoreline bloom of CyanoHABs at North Sandy Pond in 2022 (credit: R. Fisher).

Reports CyanoHAB occurrences at North Sandy Pond have been documented since 2015 (**Table 1**) through the NYSDEC HAB Alert system. Note that the counts of CyanoHABs at North Sandy Pond are a conservative estimate – the number of actual CyanoHAB events is likely higher because the reports to HAB Alert require reports from citizens or agencies to be reported to the system. Additional documentation of

CyanoHABs is possible through visualizing and assessing satellite imagery. **Appendix 1** depicts imagery from the Sentinel-2 satellite of North Sandy Pond on select dates in 2022 (April – October). The satellite imagery depicts that increased algal growth began in 2022 around late July and continued into October.

Table 1. Reported CyanoHABs at North Sandy Pond.

Year	No. of Reports	Report Type				
		Not categorized	Large localized	Small localized	Widespread	Open water
2015	1	1	--	--	--	--
2016	8	5	2	--	1	--
2018	2	--	--	2	--	--
2019	2	--	--	1	1	--
2020	1	--	--	--	1	--
2022	6	--	1	--	3	2
TOTAL:	**20**	**6**	**3**	**3**	**6**	**2**

As part of the 2022 monitoring program conducted by UFI, surface water samples were collected to be analyzed for microcystin toxins. A total of 11 toxin samples were analyzed in 2022 (**Table 2**) from mid-July to September. All surface samples analyzed had detectable concentrations of microcystin. Samples that were collected from open water locations (SAND1 and SAND2) had an average microcystin concentration of 2.5 µg/L (+/- 1.5). Toxin samples from nearshore areas, which pose a greater risk to human and animal exposure, averaged (at least) 9.48 µg/L (+/- 21.8). Note that one of the shoreline samples collected on 9/20/2022 is reported as >75 µg/L, due to the actual concentration exceeding the laboratory standard curve (*i.e.*, actual concentration above the reported value). A total of 20 microcystin toxin samples were collected in 2023, with a greater emphasis on shoreline bloom conditions compared to 2022. The average microcystin concentration in 2023 was 6.2 µg/L (+/- 14.7). Note that two samples were collected from the shoreline of South Sandy Pond in September 2023. The World Health Organization (WHO) guidance values for relative probability of acute health effects from microcystin indicate that concentrations below 10 µg/L are a low probability of effects. It is important to note that all samples collected and analyzed in 2022 and 2023 had detected levels of microcystin toxin, with some toxin concentrations approaching the WHO acute health effects thresholds, and other samples exceeding the recommended exposure concentration (**Table 2**). Microcystin samples previously analyzed represent the concentration at the time of sample collection and not all blooms and/or shoreline conditions were sampled in 2022 and 2023.

Table 2. Microcystin toxin (µg/L) concentrations from North Sandy Pond in 2022.

Date	Site	Location	Microcystin (µg/L)
7/14/2022	SAND1	OW	0.75
7/26/2022	SAND1	OW	1.9
7/26/2022	SAND2	OW	1.3
7/26/2023	Shoreline	NS	0.4
8/11/2022	SAND1	OW	4.5
8/11/2022	Shoreline	NS	2.5
8/23/2022	SAND1	OW	3.8
9/6/2022	SAND1	OW	4.2

9/20/2022	SAND1	OW	3.0
9/20/2022	Shoreline	NS	>75
9/20/2022	Shoreline	NS	7.0
8/15/2023	Seber Shores	NS	2.9
8/16/2023	SAND1	OW	0.6
8/16/2023	SAND2	OW	0.3
8/22/2023	SAND1	OW	0.9
8/22/2023	SAND2	OW	0.6
8/22/2023	Shoreline	NS	0.3
8/22/2023	Shoreline	NS	0.8
8/22/2023	Shoreline	NS	1.2
8/29/2023	Seber Shores	NS	2.5
9/5/2023	SAND1	OW	1.0
9/5/2023	Shoreline	NS	1.8
9/6/2023	Greene Point	NS	18.6
9/11/2023	Shoreline	NS	2.5
9/17/2023	Chipman Lane	NS	65.7
9/17/2023	South Sandy Pond	NS	2.0
9/25/2023	SAND1	OW	1.8
9/25/2023	SAND2	OW	1.9
9/25/2023	Shoreline	NS	2.2
9/25/2023	Shoreline	NS	12.5
9/25/2023	South Sandy Pond	NS	3.9

4.4.2 Invasive Species

Introducing aquatic species into new ecosystems can significantly disrupt local habitats and reduce water quality. Aquatic invasive species can spread rapidly and outcompete native species for resources, and may limit available aquatic habitat, potentially leading to reduced biodiversity. As populations grow, aquatic invasive species can alter food webs and cause increased nutrient availability leading to greater overall productivity and algal growth (altering stable states of freshwater lakes). Dense infestations of aquatic invasive species can drastically change aquatic conditions, degrading water quality and ecosystem function. Preventing new introductions and controlling established invasive species populations are important for maintaining quality water resources.

Limiting the negative impacts from invasive species is an ongoing process that requires frequent assessment and evaluation. The “Invasion Curve” is often used to describe how management objectives and goals change over time as the infested area or invasive species population grows (**Figure 22**). There are typically four management goals that correspond to the time, level of infestation, and anticipated related costs. Without active monitoring or public education efforts, new invasive species can become established to a point where eradication is impossible. Preventing the spread to other waters and long-term management become increasingly more expensive. In many cases, ecosystem services are extremely disrupted by proliferation of aquatic invasive species.

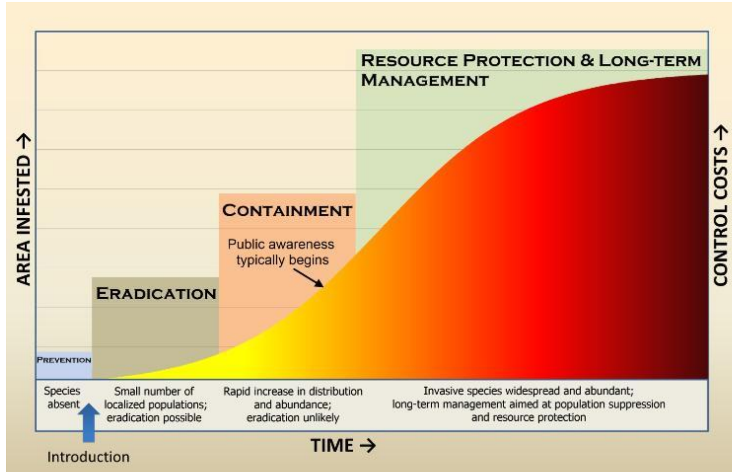

Figure 22. Invasive species management curve (source: US Army Corps of Engineers).

Based on species presence records from the NY iMapInvasive database[3], there are 15 aquatic or semi-aquatic invasive species documented at North Sandy Pond. The current list of invasive species in North Sandy Pond includes the fish species Round Goby (*Neogobius melanostomus*), multiple submerged macrophytes notably European frogbit (*Hydrocharis morsus-ranae*), Eurasian watermilfoil (*Myriophyllum spicatum*), starry stonewort (*Nitelopsis obtusa*), curly pondweed (*Potamogeton crispus*), and water chestnut (*Trapa natans*). Emergent/riparian invasive vegetation include purple loosestrife (*Lythrum salicaria*), reed canarygrass (*Phalaris arundinacea*), and phragmites (*Phragmites australis*).

Although not recorded in the NY iMapInvasive database, zebra mussels (*Dreissena polymorpha*) have been observed in North Sandy Pond. Zebra mussels are known to filter large quantities of water, which can increase water clarity, and they can selectively graze algae by preferentially excluding cyanobacteria.

5 Sources of Nutrients

North Sandy Pond is a highly productive freshwater ecosystem with elevated nutrient concentrations (particularly P) resulting in high biomass of algae during the growing season, and a large percentage of the algal assemblage represented by cyanobacteria. Nutrients enter lakes in both particulate and dissolved forms, and it is important to consider how each relates to water quality and the growth of algae. Nutrients that are attached to or incorporated into organic matter or bound to sediment (i.e., particulate forms) are less bioavailable because they cannot be used directly to support algal growth. Therefore, inputs of particulate P in the form of sediment are not an important cause of CyanoHABs. Conversely, dissolved forms of P are soluble in water and are readily available for biological uptake and use in algal growth. Dissolved P directly contributes to the nutrient needs of algae, which may result in dense algal

[3] https://www.nyimapinvasives.org

blooms and harmful impacts to aquatic life. Both forms of P contribute to the total nutrient loading in a freshwater lake, but their impact on algae differs due to variations in bioavailability. Therefore, in the management of CyanoHABs, it is critical to consider source(s) of the different forms of nutrients and attempt to target management interventions that limit the amount of dissolved forms.

5.1 Internal Loading

Nutrient cycling of P from the sediment into the water column is facilitated via several different mechanisms. Biological influences can be generated by various burrowing benthic organisms, or bottom-feeding species that disturb the sediment. Physical influences such as wind in shallow lakes can also cause re-suspension and distribute P throughout the water column. Finally, when oxygen is low, P that is otherwise bound to iron compounds in the presence of oxygen is released through a bacterially mediated reduction reaction. This newly freed P is then distributed into the anoxic hypolimnion of stratified lakes and can be a major contributor to the overall P budget in some lakes. Internally loaded P is typically made up of bioavailable forms and can contribute immediately to increased primary production. Some species of cyanobacteria can utilize this pool of available P through daily vertical migration in the water column.

Based on monitoring data from 2022, periods of thermal stratification did not occur that would result in release of bioavailable P from the sediment. This suggests that internally loaded P is not a critical source of nutrients to North Sandy Pond (although short, intermittent periods of stratification may occur directly at the sediment-water interface).

Due to the shallow nature of North Sandy Pond, and its geographic location along the Lake Ontario shoreline exposed to westerly winds, there is the potential for sediment to be re-suspended during periods of high winds. Often sediment that is re-suspended in shallow water bodies can have P associated with the solids; however, much of the P that is mixed into the water column is not available for biological production. Therefore, it is unlikely that internal loading of nutrients contributes significantly to water quality conditions at North Sandy Pond.

5.2 External Loading

The transportation of externally derived materials into a waterbody is a critical process considered in lake management and can represent a significant source of excess nutrients to some lakes. It is worth noting that sediment and nutrient transport from a watershed to a lake through streams is a natural process in a healthy, functioning ecosystem. However, during heavy rain events and/or spring snowmelt, runoff containing dissolved and particulate forms of nutrients can contribute to poor water quality conditions, particularly when excess sediment and nutrients are transported because of human activities (*e.g.*, land use/land cover in the watershed or primary discharges from wastewater treatment plants). Increasing impervious surfaces such as roads or buildings, channelization of streams, the use of on-site septic systems, agricultural practices, and landscaping are all activities that may increase the amount of material transported into lakes via runoff. An example of visible impacts that humans have on water processes in a watershed is drainage ditches and culverts – there is a need to control the flow of water to allow for use of the land as transportation (roads). These alterations can occasionally be key factors for lake water quality, but also can provide great opportunities for implementing best management practices (BMPs) within a watershed.

Areas of intensive agriculture activity can also be associated with higher rates of nutrient loading. Depending on the type of agricultural occurring in the landscape, and proximity to the stream network, bioavailable forms of nutrients may be higher in runoff compared to forested, or even developed, land uses. Finally, on-site septic systems have the potential to contribute increased nutrients directly to a lake (*e.g.*, those sited on shorelines) as well as from the larger watershed when situated near streams.

5.2.1 Tributary Inputs

Tributary monitoring was conducted by UFI from October 2022 to April 2023 on the five main tributaries draining to North Sandy Pond to document nutrient concentrations (**Table 3**).

Table 3. Watershed area, estimated flows, and nutrient concentrations (average ± standard deviation) from the six tributary sites measured over five sampling events between October 2022 and April 2023.

	Skinner Creek	Lindsey Creek	Mud Creek	Blind Creek	Little Sandy Creek North	Little Sandy Creek South
Watershed Area (hectares)	6780	3581	785	1140	5209	1038
Flow (cfs)	49.0 (± 23.7)	31.5 (± 15.0)	5.3 (± 1.7)	9.7 (± 4.5)	57.1 (± 28.2)	6.4 (± 2.0)
TSS (mg/L)	1.6 (± 1.4)	2.5 (± 2.9)	1.2 (± 0.8)	1.3 (± 0.9)	0.7 (± 0.4)	1.0 (± 0.8)
TN (µg/L)	777.3 (± 183.0)	358.8 (± 132.5)	546.2 (± 175.4)	576.7 (± 206.7)	245.8 (± 79.8)	1107.8 (± 154.2)
NOx (µg/L)	706.3 (± 142.0)	272.5 (± 84.4)	360.0 (± 126.7)	503.3 (± 191.8)	175.0 (± 41.8)	840.8 (± 209.1)
tNH3 (µg/L)	16.8 (± 21.6)	5.3 (± 0.8)	21.4 (± 16.0)	13.5 (± 11.7)	5.9 (± 2.3)	13.0 (± 11.5)
TP (µg/L)	10.5 (± 2.0)	11.4 (± 4.7)	15.0 (± 1.9)	10.9 (± 2.4)	6.6 (± 1.2)	15.5 (± 2.8)
TDP (µg/L)	6.1 (± 1.4)	4.7 (± 1.0)	9.1 (± 1.3)	7.1 (± 1.7)	4.4 (± 1.8)	8.8 (± 1.3)
SRP (µg/L)	2.9 (± 1.1)	2.1 (± 0.5)	4.3 (± 0.7)	3.5 (± 0.7)	1.8 (± 0.7)	3.6 (± 0.9)

Tributaries draining larger watersheds (e.g., Skinner Creek and the North Branch of Little Sandy Creek) had generally higher flows than those draining smaller watersheds (e.g., Mud Creek, Blind Creek and the South Branch of Little Sandy Creek). The magnitude of tributary flow and nutrient concentration determines loading and the relative impact of tributaries on water quality of North Sandy Pond.

The majority of nitrogen measured from the tributaries was inorganic (*e.g.*, NOx and NH3) – the greatest average concentration of N was from the southern tributary site of Little Sandy Creek (also referred to as Wolf Creek). Phosphorus concentrations from tributaries were generally low, with the highest average TP concentrations from Mud Creek and the southern tributary of Little Sandy Creek (**Table 3**).

Tributary nutrient concentrations over the period measured (October 2022 to April 2023) were not elevated, relative to other tributaries across NYS, and do not indicate high concentrations of nutrients entering North Sandy Pond from the five main tributaries.

Based on the monitoring data and estimated stream flows, nutrient concentration-flow relations were developed (**Appendix 2**).

5.2.2 On-site Septic Systems

The land comprising the North Sandy Creek watershed is generally limited for septic systems (**Figure 23**). Nearly all the shoreline of the lake is characterized as "very limited" for septic systems – the use of on-site septic systems in such limited soil types and in close proximity to North Sandy Pond is a likely source of nutrients and/or other contaminants to the system, especially for poorly maintained leach fields. Increased septic system use due to the conversion of seasonal to permanent households can also elevate loading, especially during periods of flooding.

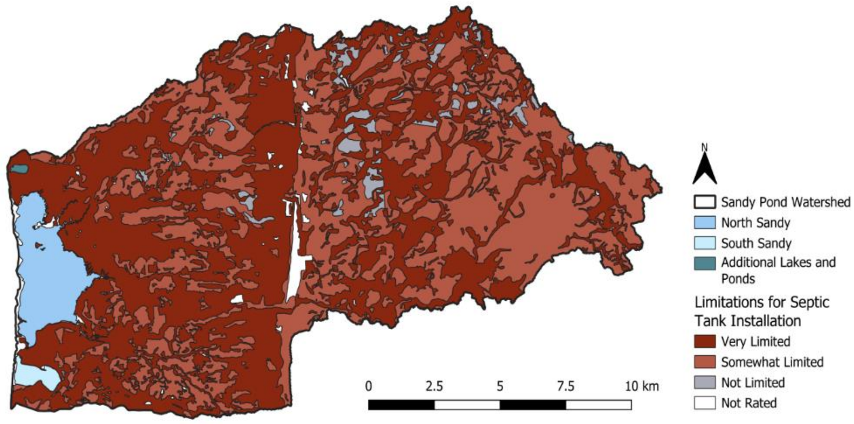

Figure 24. Soil septic suitability ratings for the North Sandy Pond watershed.

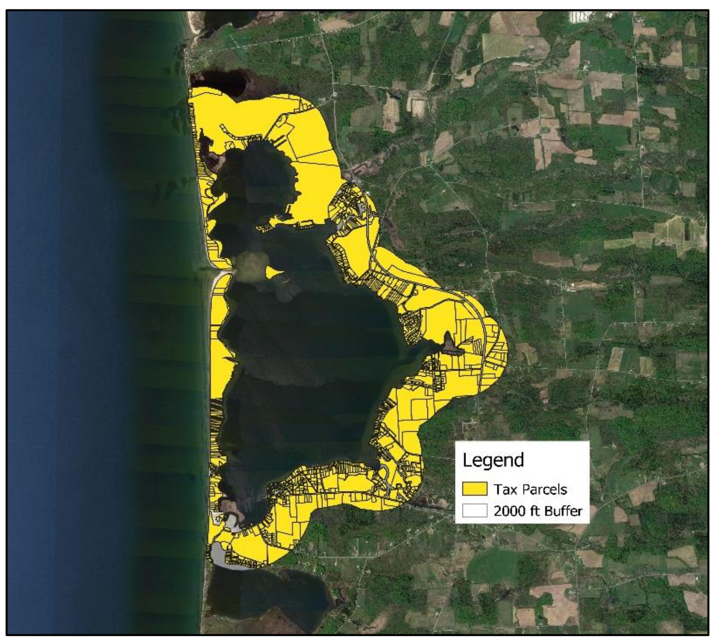

Figure 23. North Sandy Pond with a 2000-ft buffer around the shoreline, and parcels used to estimate annual septic system TP loads.

In an attempt to quantify the contribution of nutrients to North Sandy Pond, the LENS tool developed by the NYSDEC was utilized. LENS is a spreadsheet-based assessment tool that can be used to estimate nutrient loads, including septic systems, within a watershed. For the purposes of this assessment, the shoreline properties were examined due to limitations of nearshore septic systems based on soil (**Figure 23**), increased occupancy from seasonal to permanent residency, and their relative contribution to water quality conditions versus elsewhere in the watershed. A 2000-foot buffer was applied to the shoreline of North Sandy Pond using QGIS (version 3.24.2), and tax parcel information was obtained from the NYS GIS Clearinghouse and Jefferson County (**Figure 24**).

Based on the available GIS parcel data, there were a total of 993 total parcels with private septic systems within the 2000-ft buffer surrounding North Sandy Pond. The LENS tool requires the total number of septic systems (in this case within the buffer area), plus the total number and seasonal septic systems within 250-ft of a stream. Calculated P loads (as kg/yr) are based on summer and winter population coefficients (2.61 ca/system), and seasonal plant uptake of nutrients (growth of grass and other vegetation surrounding the shoreline). For this estimate, it was assumed that 75% of the total septic systems were within 250-ft of a stream (given the proximity to the five main tributaries and the lake shoreline), resulting in 745 septic systems. It was also assumed that half of the systems within 250-feet were seasonal use residences (372 septic systems). See **Appendix 3** for input and coefficients used in the LENS tool.

It was estimated that septic systems within 2000-ft of the North Sandy Pond shoreline contribute an annual P load of 164 kg/yr. Based on the area of parcels within the buffered area, the annual per-area P load was estimated to be 0.20 kg/ha/yr. Importantly, this loading not only occurs within close proximity to North Sandy Pond but also consists of dissolved, bioavailable forms of P that can support algal growth. Comparing estimated P loads from septic systems within 2,000 feet of the shoreline to total dissolved P from the tributaries (based on data presented in **Table 3**), scaled to kg/ha/yr, it is estimated that approximately 43% of the dissolved P load is from nearshore septic systems. Note that high density of septic systems adjacent to Little Sandy Creek in the Towns of Sandy Creek and Lacona were not evaluated as part of this nearshore evaluation. Therefore, the increase in TP, TN, and chlorophyll-a (estimated algal biomass) over the growing season is a possible response to cumulative septic system loading from the nearshore zone of North Sandy Pond.

6 Recommended Management Actions

The existing information on water quality of North Sandy Pond strongly suggests that internal nutrient loading is not a primary source of nutrients impacting water quality and the occurrence of CyanoHABs. Therefore, management actions identified herein (and described below) focus on external nutrient loads and related actions that could be considered, implemented, and evaluated.

6.1 Reduce External Load of Nutrients

6.1.1 Improved On-site Wastewater Collection and Treatment

Based on the best available information to date, septic systems surrounding the shoreline of North Sandy Pond appear to represent approximately 43% P load to North Sandy Pond. Given the proximity of nearshore septic systems to the lake, their densities relative to other areas of the watershed, and recent conversion of properties from seasonal to permanent use, septic systems appear to be a major contributor to degraded water quality observed. There are multiple ways septic systems can fail to sequester or decontaminate wastewater (**Table 4**). Nutrients in septic seepage are predominately in dissolved forms, which are readily available for uptake by primary producers such as algae and aquatic plants. Actions can be taken at the homeowner and local government level to address septic system failure and decrease the likelihood of contamination in groundwater and the lake.

Table 4. Common causes of septic system failure (adapted from EPA 2005).

Type of failure	Underlying cause
Hydraulic	Undersized, low soil permeability, poor maintenance
Organic	Excessive loading from unpumped, sludge-filled tanks
Soil depth to groundwater or bedrock	Not enough soil between system and groundwater to properly allow pathogen removal and maintain hydraulic performance
System age	Systems > 25 years with irregular pumping/maintenance
Design	Wastewater strength, flow, geology, or position not considered during initial installation
System density	Combined effluent load from all systems in watershed or groundwater recharge area exceeds hydrologic capacity to accept or treat effluent

Considerations for a proper upkeep septic system and upkeep include:

- Routinely have the system pumped and inspected
  - Every 3-5 years is recommended, based on usage
- Be mindful what is being flushed into the system
  - Septic systems are intended by human waste and associated products (i.e., septic-safe toilet paper)
  - Avoid flushing of greases, pesticides, paper towels, coffee grounds, wet wipes, feminine products, cigarettes, pharmaceuticals, etc. that are not intended to be treated in a septic system and may cause premature failure
- Garbage disposal usage can accumulate solid sludge faster than bacteria can digest it
  - Septic tank pumping should be performed more frequently with heavy garbage disposal use
- Avoid high pressure and heavy weight on the drain field
  - Most drain fields are constructed in an open space and are not built to withstand the weight of heavy equipment such as vehicles, sheds, etc.
- Recognize the symptoms of septic problems
  - Signs of improper function include puddles or exceedingly greener grass above the drain field, indoor backups, strong odors from the yard, etc.

The feasibility of sewering the shoreline of North Sandy Pond has been previously evaluated by the Town of Sandy Creek (see Barton & Loguidice 2019). The capital cost(s) to accomplish a sewering project exceeded the capacity of local resources. Based on all pertinent information to date suggests that sewering the shoreline of North Sandy Pond is the best approach to have a tangible, positive impact on improving the water quality of the lake. Additional assessment and data collection of the need for a complete shoreline sewering project at North Sandy Pond may assist in providing further justification to state and/or federal resources to accomplish such an undertaking.

Recommended Action(s):

1. Consider implementing a monitoring program to document septic system failure rates, specific to North Sandy Pond, which may include visual/olfactory screening, bacterial or chemical indicator studies, nearshore optical brightener data collection, dye testing, and/or color infrared aerial photography.
2. Continue to explore funding sources, opportunities, and means to conduct a sewering project for North Sandy Pond.
3. Support private property owners in seeking funds for upgrades and/or new septic systems to implement new technologies and replace antiquated infrastructure.
4. Evaluate the feasibility and applicability of implementing a Town or County septic system inspection program.
5. Educate property owners about the importance of septic system maintenance and how faulty septic systems can negatively impact water quality.

6.1.2 Agricultural Best Management Practices

Advances in farming techniques and management practices can help balance food and fiber production with water quality concerns. Researchers and practitioners from the farming community, land grant universities, cooperative extension, federal, state, and county level agricultural support agencies including Soil and Water Conservation Districts (SWCDs), agricultural consultants, and many other professionals have developed and shared a myriad of Best Management Practices (BMPs). BMPs are designed to enhance natural infiltration of precipitation, minimize loss of sediment and applied chemicals, and protect land and water for future generations.

Some BMPs are classified as structural: examples include measure to redirect water flow away from barnyards, construction of basins designed to increase infiltration of water, fencing to limit livestock from riparian zones, and increased storage capacity and efficient use of animal waste products. Other BMPs are non-structural and include vegetative measures such as buffer strips, setback requirements, cover crops, and/or rotation of crop/grazing fields. Finally, operational BMPs can by varied – an example may include optimizing livestock diets to reduce nutrients in manure, using technology to leverage weather predictions to reduce risk of sediment loss, and detailed tracking of fertilizer applications (*e.g.*, amount, placement, and timing).

The most appropriate BMPs will vary from farm-to-farm. Assistance is available from various agencies and local organizations for farmers to develop management plans that will benefit their business and limit environmental impacts (**Table 5**).

Table 5. Summary of NYS Soil and Water Conservation Committee's agricultural programs.

Program	Overview
Agricultural Environmental Management (AEM)	Voluntary, incentive-based program that helps farms identify environmental risks and make cost-effective, science-based decisions that will help their business and conserve local natural resources. Multi-tiered to help farms progress from planning to implementation phases.

Agricultural Non-Point Source Abatement and Control Program	Cost-sharing grant program that can assist with the planning or implementation of management practices.
Comprehensive Nutrient Management Planning	As part of AEM, certified professionals can evaluate all aspects of farm production and develop conservation goals.
Climate Resilient Farming (CRF)	Grant program awarded through county SWCDs to mitigate impact of agriculture on climate change and increase resilience to climate change.
Source Water Buffer Program	Grant program awarded through county SWCDs on behalf of farmers that have completed Tier 1 and 2 of AEM and are located directly adjacent to waters designated as a drinking water source.

Recommended Action(s):

1. Continue to foster relationships with SWCDs of Oswego and Jefferson Counties and local farmers to implement BMPs and leverage available resources, funding, and expertise.

6.1.3 Lawn Care Best Management Practices

While having a manicured lawn is aesthetically pleasing, landscaping can have important impacts on lakes if done without care and foresight. Each year in the U.S. an estimated 80 million pounds of pesticides and 90 million pounds of fertilizers are used on lawns (Atwood and Paisley-Jones 2017). Runoff from fertilized lawns can contribute nutrients to the lake that adversely impact water quality. Soils tests for phosphorus and potassium content is a valuable first step to determine if lawn fertilizers are necessary and if so, to select the best formulation for a specific property to minimize over fertilization. New York State enacted the Nutrient Runoff Law in 2012 (NYS Environmental Conservation Law, article 17, title 21 and Agriculture and Markets Law § 146-g) with the goal of addressing nonpoint source nutrient inputs from residential lawns. This law includes the following requirements for lawn fertilization in NYS:

- Do not use lawn fertilizer that contains phosphorus (unless establishing a new lawn or a soil test determines need for additional phosphorus)
- Do not apply any lawn fertilizer between December 1 to April 1
- Do not apply lawn fertilizer on any impervious surfaces, including but not limited to driveways and sidewalks
- Do not apply lawn fertilizer within 20 feet of any water body, unless
    - There is *at least* a 10-foot buffer of shrubs, trees, or other plants between the area fertilizing and the water
    - Fertilizer can be applied no closer than 3 feet from the water using a device such as a spreader guard, deflector shield, or drop spreader.

The Nutrient Runoff Law applies to homeowners fertilizing their lawn, and professional landscapes and lawn care professionals. The first documented violation of the Nutrient Runoff Law includes written warning and educational materials, followed by a fine of $100 for a second violation, and fines up to $250 for repeated violations.

Recommended Action(s):

1. Educate shoreline property owners at North Sandy Pond and residents of the watershed about the proper use of lawn fertilizers according to the 2012 Nutrient Runoff Law.
2. Encourage property owners to assess soils to demonstrate a need for lawn fertilizers through local Cornell Cooperative Extension office, or the use of at-home soil test kits.

6.1.4 Education, Outreach, and Engagement

Successful lake management always relies upon a vested interest among lake residents and stakeholders. Engagement through lake associations, town boards, and/or local conservation organizations are excellent ways to generate a sense of community, develop shared goals, and recognize the diversity of intended lake uses for community members at large. State-wide programs such as the Citizen Statewide Lake Assessment Program (CSLAP), aim to provide education to lake residents and provide a better understanding water quality patterns in lakes over time. Participation in CSLAP requires the establishment of a lake association with membership in the New York State Federation of Lake Associations (NYSFOLA). CSLAP provides training, equipment, and evaluation, which allows lake association volunteers to collect samples.

Beyond monitoring programs such as CSLAP, there are numerous benefits to lake associations in the context of lake conservation and advocacy. Some examples may include:

- Organizing shoreline cleanups and invasive species removal efforts to promote stewardship and biodiversity
- Educational opportunities for homeowners on landscaping BMPs that reduce runoff and pollution
- Advocate for policies, programs, and actions to protect shorelines, habitat, and water quality giving residents a collective voice in the local community
- Restoration efforts, such as improvements to shoreline vegetation and natural buffers to filter nutrients and pollutants

Lake associations can take many forms and can be structured to be voluntary with minimal long-term commitment(s) from participants over time. The value of a lake association often far outpaces the potential hurdles of establishing an organizational structure and governance.

Additional education and outreach that would benefit the broader community would include public signs or plaques that highlight the unique history, ecosystem, water quality, and/or ongoing management of North Sandy Pond to educate visitors and encourage lake-friendly actions.

Recommended Action(s):

1. Explore the willingness of residents along North Sandy Pond to establish a lake association, potentially working with NYSFOLA for guidance and insight on the process, procedures, and requirements.
2. Develop educational material that conveys the history, ongoing efforts, and future vision for North Sandy Pond, and consider signage at the public boat launch to highlight such material.

3. Leverage available resources regarding CyanoHABs to inform residents and visitors of the potential risks of exposure to toxins for public health, pets, and wildlife[4].
4. Consider developing CyanoHABs education and outreach materials specific to North Sandy Pond.

6.2 Water Exchange and Flushing

Due to the unique geology and landscape setting of North Sandy Pond, the area is a sink for a large amount of sediment from Lake Ontario. As a result, the unique and dynamic dune system was created and continued inputs of sand and sediment are introduced in proximity to the outlet of North Sandy Pond. Over time the input of sand and sediment has caused the outlet of North Sandy Pond to migrate northward, the outlet channel to become restricted, and the formation of a large sand bar between the outlet channel and Carl Island. It has been hypothesized that increasing water exchange with Lake Ontario would improve water quality of North Sandy Pond by flushing and diluting excess nutrients that contribute to algal growth. Increased water exchange between Lake Ontario and North Sandy Pond could potentially be achieved through periodic dredging of the sand bar that has formed near the Pond outlet. Dredging of this area would also allow for safe navigation in and out of the Pond for a variety of vessels and the attendant economic and recreational benefits. The dredged sand material could be placed on the dune system to help maintain the unique barrier ecosystem.

Recommended Action(s):

1. Engage with local, state, and federal stakeholders to evaluate if increased water exchange with Lake Ontario would provide a water quality benefit to North Sandy Pond. This evaluation would include data collection, monitoring, and modeling.

6.3 Invasive Species Management

Aquatic and semi-aquatic invasive species can easily spread into and from North Sandy Pond given its proximity to other waterbodies in the southeastern Lake Ontario basin, proximity to the Adirondacks, and its popularity with the recreational boat and fishing communities. Boaters who transport watercraft from other waterbodies to North Sandy Pond and utilize the public boat launch should follow proper procedures for cleaning and disinfecting boats and trailers. Additionally, terrestrial invasive species can have a negative impact on water quality through deforestation of stream riparian zones and large tracks of intact forests.

Recommended Action(s):

1. Continue to maintain signage, and update as necessary, to inform public water users of the importance of invasive species management and vigilance to limit the spread of species across NYS and North Sandy Pond in particular.
2. Monitor iMapInvasives for updated records of species documented in North Sandy Pond, and the watershed, to identify newly introduced species and consider rapid response actions as appropriate if/when new species are introduced.

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[4] Information available at https://www.dec.ny.gov/chemical/77118.html.

3. Continue to engage with the St. Lawrence Eastern Lake Ontario (SLELO) Partnership for Regional Invasive Species Management (PRISM) for guidance, BMPs, and potential rapid response/management actions to limit current and future populations of invasive species at North Sandy Pond.

6.4 Monitoring and Evaluation

As stated above, long-term data are essential for assessing water quality patterns and changes, and to effectively evaluate different lake management alternatives. This is one of the key values in participating in a monitoring program, such as the Citizen Statewide Lake Assessment Program (CSLAP).

An adaptive management approach is recommended for North Sandy Pond and its watershed. Adaptive management is a "build and measure" approach that acknowledges uncertainties and uses data and information to define next steps (**Figure 25**). This is a flexible approach for providing effective management practices within the watershed with the goal of improving water quality and minimizing the negative impacts from CyanoHABs. Participating in a lake monitoring program, such as CSLAP, will be a critical first step to advance an adaptive management framework.

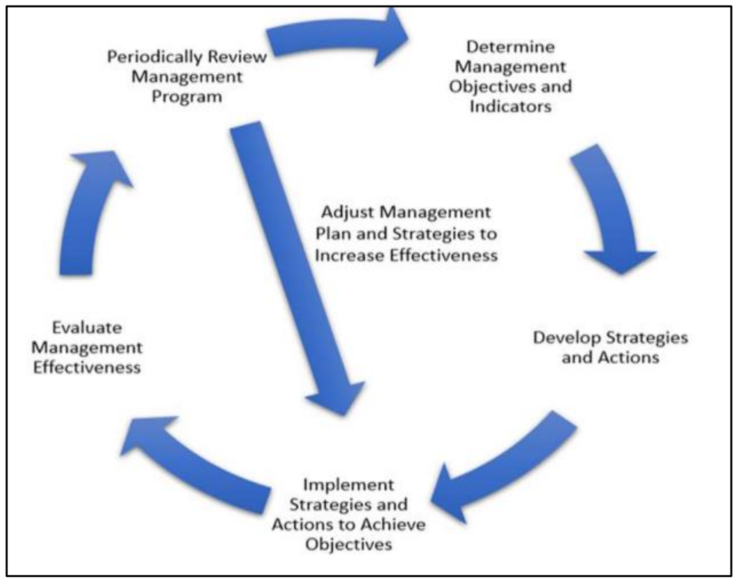


Figure 25. Diagram of adaptive management process.

Existing information to date suggests that external nutrient loading, particularly from nearshore septic systems, is the leading source of nutrients to North Sandy Pond. Building on other efforts in the region, such as the ongoing Sandy Creeks Nine Element Watershed Plan (Sandy Creeks 9EP) lead by Jefferson and Oswego County Soil and Water Conservation Districts and water quality monitoring in 2023, will be valuable to evaluate additional tributary loading data and water quality conditions. This management plan can be updated periodically as additional information regarding water quality parameters are obtained, management techniques are further vetted, resources are available, and overall management objectives of North Sandy Pond change.

References

Atwood, D. and C. Paisley-Jones. 2017. Pesticides Industry Sales and Usage, 2008-2012 Market Estimates. U.S. Environmental Protection Agency, Biological and Economic Analysis Division. https://www.epa.gov/sites/default/files/2017-01/documents/pesticides-industry-sales-usage-2016_0.pdf.

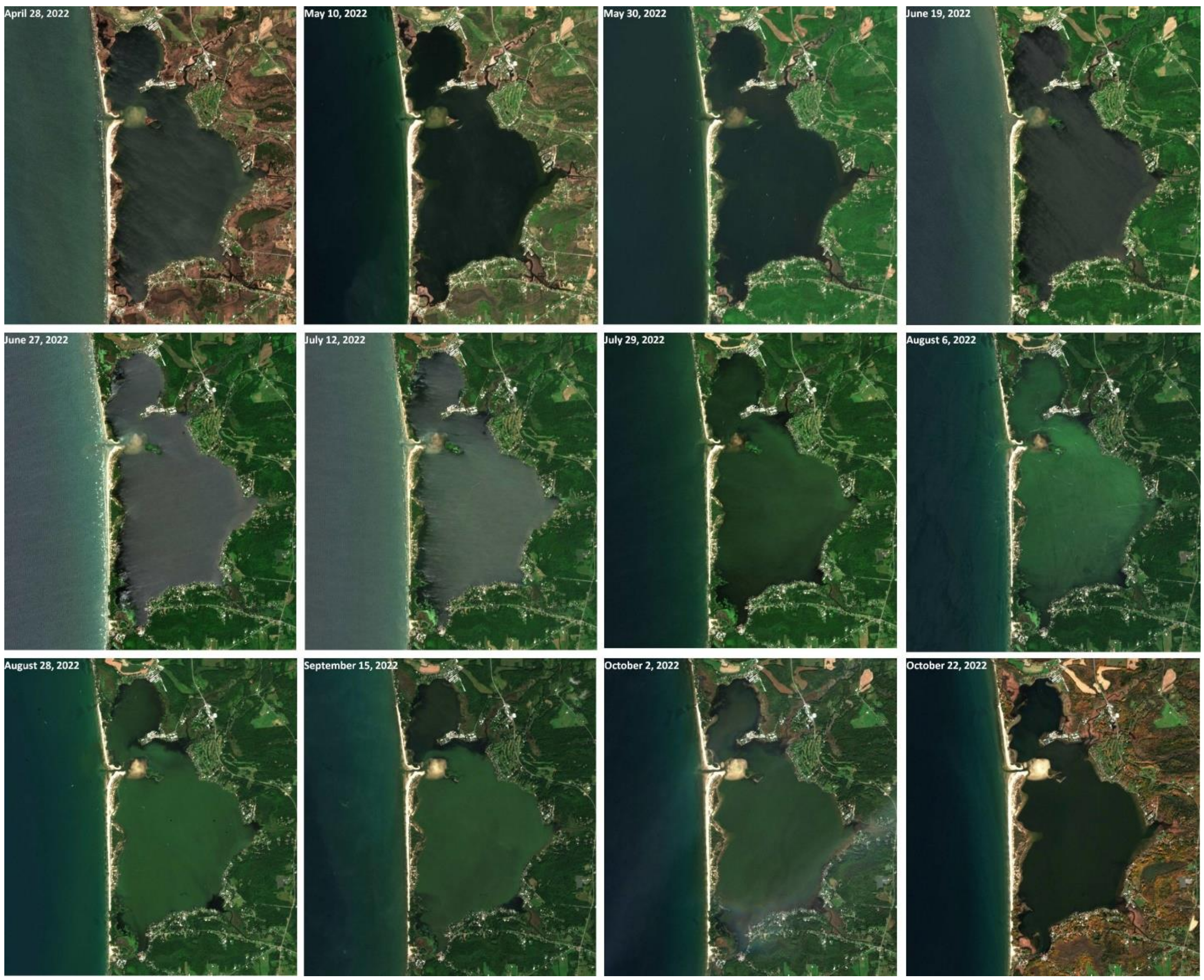
Barton & Loguidice. 2019. Preliminary Engineering Report – Town of Sandy Creek North & South Sandy Pond Sewer Project. August 2019. 40 pp.

NYSDEC. 2016. Lake Ontario/Little Sandy Creek Watershed (0414010204). WI/PWL Fact Sheets - Lake Ontario/Little Sandy Creek Watershed (0414010204) (ny.gov)

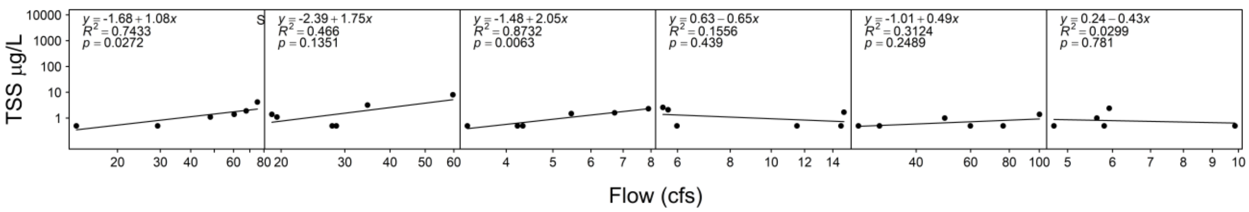
Appendices

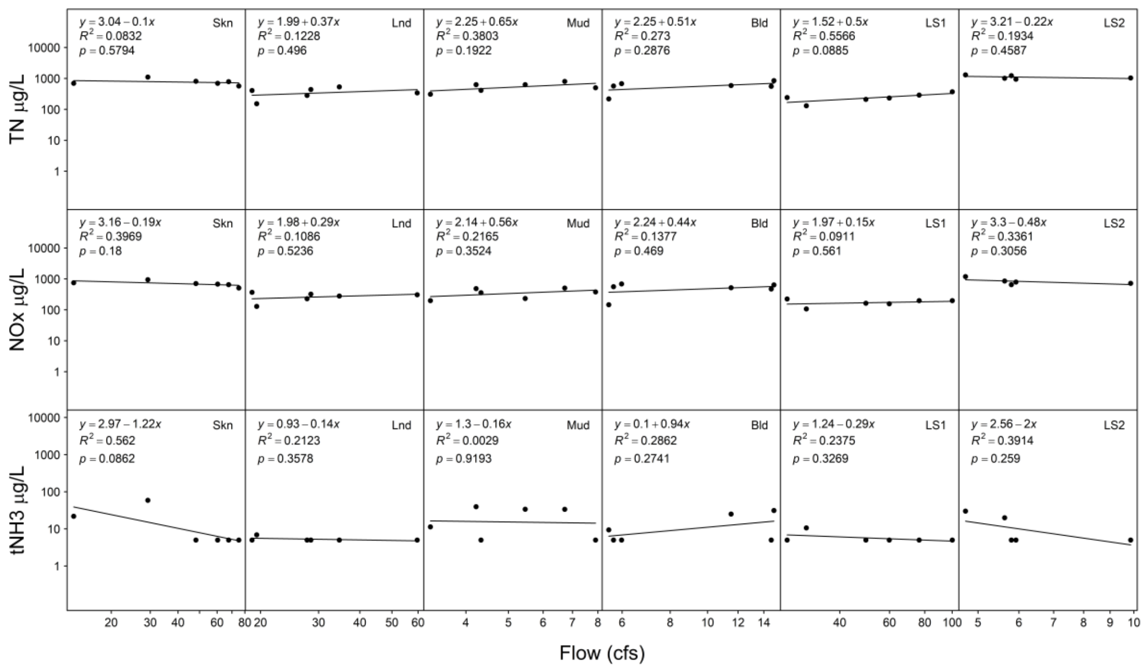
Appendix 1 – Sentinel-2 Satellite Imagery

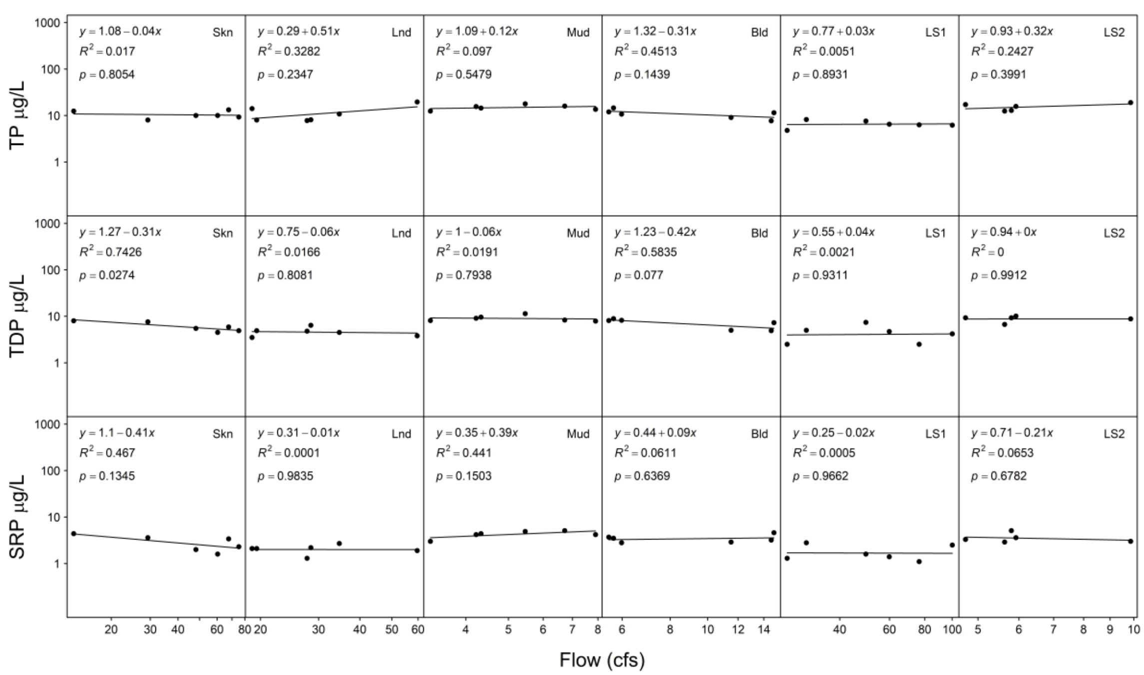
April – October 2022



Appendix 2 – Tributary Concentration-Flow Relations







Appendix 3 – NYSDEC LENS tool Septic System Load Estimate

PARAMETER	VALUE	NOTES
Total number of septics in watershed	**993**	
Septic w/in 250 ft of stream	**745**	75% of total septic systems
Seasonal septic w/in 250 ft of stream	**372**	
% w/in 250 ft of stream	75%	
Summer population (2.61 ca/system)	1,944	U.S. Census Bureau, 2019
Winter population (2.61 ca/system)	974	U.S. Census Bureau, 2019
P load (g/ca/d)	1.5	Douglas et al. 1992
Winter P load (kg/yr)	67	Caraco 2013
May-Oct P uptake (g/ca/d)	0.4	Douglas et al. 1992
Summer P load (kg/yr)	98	Caraco 2013
Total septic loading failing systems (kg/yr)	**164**	