September 20, 2021

Waynoka Property Owners Association
ATTN: Paul Cahall, General Manager
1 Waynoka Drive
Lake Waynoka, OH 45171

Subject: Condition assessment of Lake Waynoka in Brown County, Ohio

Dear Paul:

At the request of the Waynoka Property Owners Association (WPOA), MAD Scientist Associates, LLC (MAD) visited Lake Waynoka in Brown County, Ohio, to conduct an evaluation of nuisance vegetation growing in the lake.

Methods:

Chief Scientist Mark Dilley and aquatic ecologist Jenna Roller-Knapp (Team) surveyed the site on August 18, 2021, between 11am and 2pm, with assistance from Tim Redick, who captained the WPOA patrol boat for the site tour. During this visit, the Team sampled 4 distinct areas within the central (#1), eastern (#2), western (#3) and southern (#4) portions of the lake (Figure 1). At each location, the Team collected water quality using a Portable Multiparameter Water Quality Meter (YSI pro quatro) including temperature, dissolved oxygen (DO), conductivity (SPC), pH, turbidity, electrical resistivity (kΩcm), Nitrates ($NO^3_N$), Salinity, and Total Dissolved Solids (TDS). In addition, depth was measured using a portable handheld sonar (depth sounder), turbidity was measured using a turbidimeter, and visibility was measured using a secchi disk. The Team also collected data on the locations and species of submerged aquatic vegetation (SAV). A photolog of select field observations can be found in Appendix A.

General Findings

The aquatic biota in and around the lake appears healthy. Numerous large spiny softshell turtles (*Apalone spinifera*), baby northern map turtles (*Graptemys geographica*) and schools of bait fish (*e.g.*, sunfish, crappie, etc.) were observed. In addition, personal accounts of excellent fishing (*e.g.,* desirable numbers, species, and size) were shared. Balancing a healthy aquatic community, recreational fishing opportunities, and good swimming and boating conditions for residents are key objectives for the WPOA.

Leafy pondweed (*Potamogeten natans*), Cattail (*Typha* sp.), American lotus (*Nelumbo lutea*) and filamentous algae (*Spirogyra* sp.) were observed in various areas, but in low amounts (Appendix A, Photograph 1). Brittle naiad (*Najas minor*) was the primary submersed aquatic plant observed, and it was locally very abundant and often found in large masses where present. This SAV has reached sufficient densities that it is considered a nuisance (Appendix A, Photographs 2-3).

Measured lake depths ranged from 0 to approximately 35 feet. SAV tends to occur in less than 10 feet of water. However, dense SAV was not consistently observed in areas of the lake within this depth range. In some sections of the lake, shallow areas contained abundant SAV while in other shallow areas around the lake SAV was absent. The deepest areas in the lake had no SAV (Appendix A, Photograph 4).

Water quality does not appear to be a primary factor driving where vegetation was growing. There were few differences observed among the four water quality sampling locations (Figure 1, Appendix B). There was also no apparent trend between water quality parameters among areas that had abundant SAV and areas with none. This is an area for continued research if more sampling is feasible in the future. Other factors, such as the proximity of propagule sources (seeds, plant fragments, etc.), sediment quality, sunlight exposure, water currents/wave action, and the efficacy of chemical treatments may be responsible for the uneven distribution.

General Community Management Recommendations:

The WPOA Lake Advisory Committee may wish to consider implementing a rule to limit the use of fertilizers near the lake, especially in areas where it would runoff directly into the lake without first passing through a dense, natural vegetated buffer. For properties where there is no such buffer (Appendix A, Photographs 5-6), WPOA could encourage residents to establish one by leaving an unmowed area, possibly planted with native herbaceous vegetation, at the edge of their property to absorb nutrients before they reach the lake (Appendix A, Photograph 7). This recommendation is important to reducing nitrogen and phosphorus loading into the lake. These nutrients promote SAV and algal growth, so reducing the loading will have a positive effect – especially if the use of natural buffers is widely adopted. Establishing additional natural buffers within the lake's watershed will further reduce runoff inputs from non-point sources such as agriculture and general property owner fertilization, providing a more sustainable, long-term solution to benefit the lake system.

Based on dredging having taken place in the last five years and occurring on the day of the site visit (Appendix A, Photograph 8), disturbance and transfer of materials from the substrate back into the water column may increase nutrient availability and growth of aquatic vegetation. Because of the recreationally-active community around the lake, dredging is expected to be an ongoing activity. Maintaining a calendar and schedule to notify the responsible parties of dredging activities is recommended. MAD recommends that the WPOA schedules dredging outside of the growing season and only as necessary during the summer months (and only in areas where SAV is not prevalent) to reduce the spread of SAV.

*Vegetation Management Measures NOT Recommended:*

Brittle naiad is an annual and fragile plant, as the name suggests. It starts growing early in the season and spreads through seeds and plant fragments. Even a small piece that breaks off can be transferred and spread elsewhere; thus, mechanical treatment is not recommended. Herbicide treatment can be conducted using a wide range of aquatic use herbicides, including but not limited to endothall, fluridone, diquat dibromide and flumioxazin. These treatments may also have damaging effects to other aquatic life. Copper Sulfate is another method of control, but as observed with previous treatments of Copper Sulfate in Lake Waynoka, the SAV rebounds after only a few weeks post-treatment.

*Biological Control*

Biological control of aquatic plants (including SAV) using triploid (sterile) grass carp (*Ctenopharyngodon idella*) is an effective treatment that has benefited Lake Waynoka historically. While the grass carp provided effective control of the SAV in recent years, their limited lifespan and the populations' die off may have been a primary factor in the increased growth of SAV seen in the past year.

The Ohio Department of Natural Resources recommends stocking 5 fish per acre when aquatic vegetation covers approximately 25% of the lake. We recommend stocking at a low rate (3 sterile grass carp per acre) for a total of 900 grass carp in the approximate 300-area lake. This will curtail the spread of SAV and enhance swimming areas, while still allowing some SAV to remain for healthy aquatic biota.

*Other Controls*

In addition to the reintroduction of sterile grass carp into Lake Waynoka, MAD suggests the following vegetation management remedies as options for implementation:

- Retaining walls could be installed near shore to allow the aquatic vegetation a place to grow during high water. Docks could extend beyond these walls to allow for swimming in deeper water. This option may be costly and require long term maintenance.
- Water lotus (*Nelumbo lutea*) could be planted to replace the water naiad that is growing. This would still provide habitat for aquatic life and preserve the existing high-quality fisheries yet reduce the undesirable monoculture of aquatic vegetation that is currently present. The large leaves of water lotus will create deep shade in the shallows, reducing SAV growth.
- Aquashade could be used to reduce the light penetration in areas where aquatic vegetation is growing abundantly. Although non-toxic, this is a short-term solution and can cause negative impacts to aquatic life.

MAD recommends that the WPAO consider these options to support habitat for biota, enhance the water quality and maintain recreational value of the lake. MAD can implement a variety of these treatment methods described in specific locations as a small-scale research effort to determine which options in Lake

Waynoka will work best considering the multitude of factors at play within this large, but narrow lake ecosystem.

Alternatively, if none of these initial remedies are desired, MAD can conduct further research and/or sampling to evaluate which factors are most greatly affecting water vegetation growth around the lake before implementing any of the recommended remedies. For example, some questions of interest include whether the amount of shade or wave action in specific areas is preventing the establishment of SAV or if nutrients not measured as part of the initial site visit are affecting the abundance of SAV.

Please contact us to discuss comments or questions. We can be reached at 614-818-9156 or via email at jenna@madscientistassociates.net and mark@madscientistassociates.net.

Best Regards,

Jenna Roller-Knapp, M.S.
Aquatic Ecologist

Mark A. Dilley, M.S.
Chief Scientist

Figure

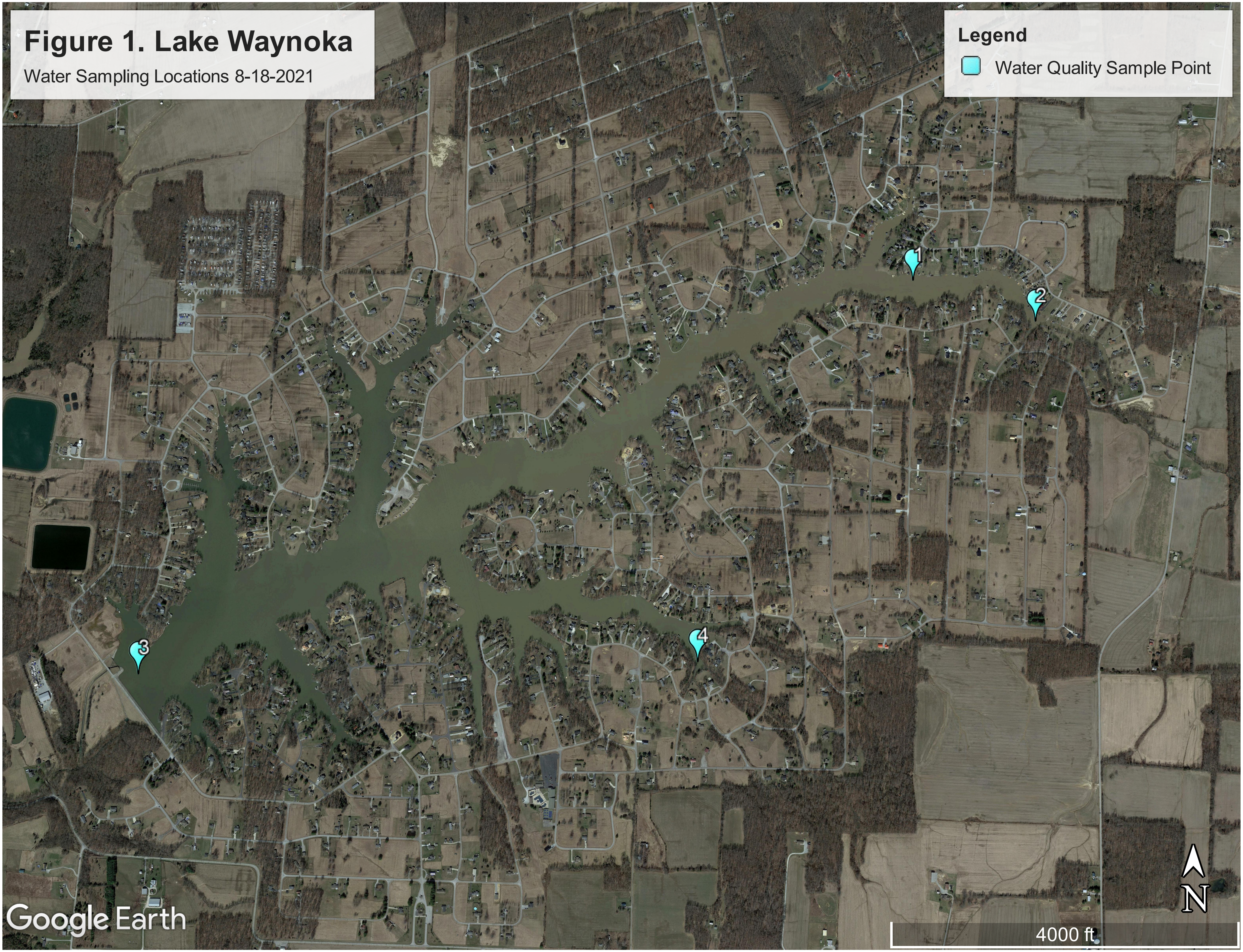
Figure 1. Lake Waynoka
Water Sampling Locations 8-18-2021
Legend
Water Quality Sample Point
1
2
3
4
Google Earth
N
4000 ft

# Appendix A

Photograph 1. General view of Lake Waynoka on the day of sampling. Few homes have natural habitat such as cattails (*Typha sp.*). Photograph taken in central region of Lake.

Photograph 2. Brittle naiad (*Najas minor*) spread in various amounts throughout the lake.


Photograph 3. Submerged aquatic vegetation (SAV) causing a nuisance by getting stuck on boat propeller.


Photograph 4. Deepest area of Lake Waynoka sampled (western portion; #3) which was 35 feet deep and had no SAV present.

Photograph 5. Many homes had no natural buffer between mowed lawn and lake.

Photograph 6. Additional properties had no natural buffer between mowed lawn and lake.

Photograph 7. Example of property with lush natural buffer that prevents high nutrient run-off from entering the lake.

Photograph 8. Observation of a dredging boat carrying loads of sediment (and feasibly SAV) across the lake. Photograph taken from the back of the patrol boat.

Appendix B

**Water Quality Summary from data collected from four sampling locations within Lake Waynoka on 8-18-2021.**

| General Lake Location | Site # | Depth (ft) | Visibility (in) | Turbidity (NTU) | Temperature (°C) | Dissolved Oxygen (mg/L) | Specific Conductivity (umho/cm) | Electrical resistivity (kΩcm) | Total Dissolved Solids (g/L) | Salinity (ppt) | pH | Nitrates ($NO_3N$; mg/L) | Amount of SAV* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Central | 1 | 4.3 | 34 | 4.54 | 26.7 | 4.23 | 0.1932 | 5.17 | 0.1256 | 0.09 | 7.84 | 1.65 | 3 |
| Eastern | 2 | 2.5 | 29 | 6.36 | 26.4 | 5.3 | 0.203 | 4.92 | 0.132 | 0.1 | 8.22 | 1.16 | 2 |
| Western | 3 | 34.9 | 60 | 2.75 | 27.8 | 5.75 | 0.1925 | 5.19 | 0.1251 | 0.09 | 8.27 | 1.38 | 1 |
| Southern | 4 | 3.9 | 46 | 4.23 | 27.8 | 4.88 | 0.1951 | 5.12 | 0.1269 | 0.1 | 7.89 | 1.03 | 2 |

*Amount of SAV:
1: None;
2: Minimal vegetation;
3: Abundant SAV and filamentous algae