Western Lake Erie Basin Drinking Water Systems:
Harmful Algal Bloom Cost of Intervention

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Alliance for the Great Lakes

Executive Summary

Fueled by excessive nutrient inputs, primarily from agricultural land use, harmful algal blooms (HABs) occur regularly in the Western Lake Erie Basin (WLEB). These algal blooms, which can produce harmful cyanotoxins (a common one being microcystin), are especially common in the nutrient-rich waters of the WLEB in late summer, including portions of some rivers and streams in the WLEB. The 2014 Toledo water crisis shed a new, more public light on the human impacts associated with HABs. Following the 2014 crisis — and a new 2016 Ohio EPA rule that requires all public water systems using surface water to test for microcystins in source water and finished drinking water— public water facilities undertook additional HAB monitoring and testing protocols. While additional monitoring and treatment protocols are certainly important for human health, these activities come with a very real financial burden for drinking water facilities and, consequently, ratepayers.

In 2020, the Ohio EPA's Division of Drinking and Groundwater surveyed 108 public water supplies (which includes 121 individual facilities) to better understand the costs associated with capital expenditures for facility upgrades, source water monitoring, treatment technology (i.e., filtration, chemical, ozone), and HAB residuals disposal. Alliance for the Great Lakes requested and reviewed the survey results and found that HAB-related monitoring and treatment costs Ohio residents using Lake Erie as their water source (within the municipalities surveyed), on an annual per-capita basis, an average of $10.48, with the annual per-capita cost to residents of Toledo being $18.76. This means that a family of five in Toledo is paying close to an additional $100 per year to deal with HABs. As water grows increasingly unaffordable for Toledo residents and source water within the Western Lake Erie Basin continues to degrade, it is imperative that the state and federal administration do not allow the costs for addressing agricultural runoff to fall solely on downstream ratepayers.

For more information about this report, contact Tom Zimnicki, Alliance for the Great Lakes Agriculture and Restoration Director, at tzimnicki@greatlakes.org

Background and Introduction

Harmful algal blooms (HABs) occur regularly in the Western Lake Erie Basin (WLEB). Produced by cyanobacteria (blue-green algae), HABs are especially common in the nutrient-rich waters of the WLEB in late summer, including portions of some rivers and streams in the WLEB. For the purposes of this case study, the WLEB includes any waters within the boundaries of the Maumee Nutrient Total Maximum Daily Load project that serve as water sources for public water systems (PWSs). Collectively, surface waters in this analysis provide drinking water for over 1 million people in the region. The occurrence of HABs can complicate drinking water treatment processes and raise costs for PWSs, and consequently, ratepayers. This study characterizes HAB-related expenses related to upgrades, monitoring, treatment, and disposal of residuals at water treatment plants (WTPs), based on the findings of a 2020 survey administered by the Ohio EPA's Division of Drinking and Groundwater (DDAGW).

HAB Prevalence and Effects

Of the various cyanotoxins that HABs produce, microcystins are the most prevalent in the WLEB. The Ohio Environmental Protection Agency (OEPA) has tracked microcystin detections greater than 1.6 micrograms of microcystins per liter (µg/L) in PWS source waters since 2010, and the statewide results are shown in Figure 1.

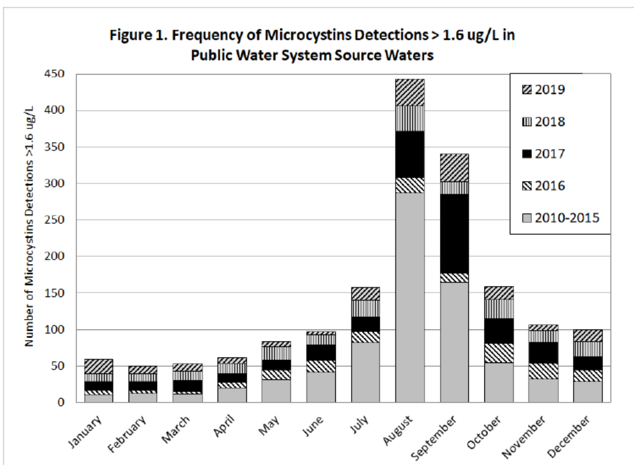

Figure 1. Ohio statewide microcystin detections in PWS source waters 2010-2019. Source: Public Water System Harmful Algal Bloom Response Strategy, OEPA, 2020.

The U.S. Environmental Protection Agency's 10-day exposure guidelines for avoiding adverse health effects from microcystins in drinking water specify no more than 0.3 µg/L for children under the age of 6 and other vulnerable populations, and no more than 1.6 µg/L for anyone over the age of 6. As shown in Figure 1, over a ten-year period, close to 800 detections were reported during the critical months of August and September. These months are particularly important because many people interact with surface water during those months. Unfortunately, Figure 1 does not include detections between 0.3 µg/L and 1.6 µg/L, which would increase the total quantity of detections shown and depress the pattern of seasonal variation.

Figure 2 illustrates source waters within the WLEB — as defined above — and health-based microcystin threshold exceedance(s) at that site during the selected time frame. The yellow, orange, and red pins indicate PWS source water concentrations at or above 0.3, 1.6, and 8.0 µg/L, respectively. For reference, 8 µg/L is the microcystins threshold value for recreational uses. Blue pins represent non-detect samples, and green pins represent concentrations of less than 0.3 µg/L. In addition to potentially serious health effects from cyanotoxins, cyanobacteria can also cause drinking water taste and odor issues. To address HABs, PWSs may need to implement additional source water monitoring, in-plant treatment

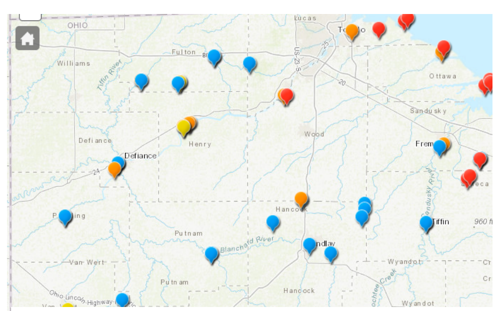

Figure 2. Geographic distribution of PWS source water microcystin detections 2012-2021. Source: OEPA Harmful Algal Blooms Monitoring dashboard.

technologies, and ultimately disposal of HAB residuals, all of which may require new and/or increasing investments.

PWSs Costs of Intervention

The costs to PWSs related to HABs include capital expenditures for facility upgrades; ongoing costs for source water monitoring and algae control; in-plant treatment, such as filtration, chemical, and ozone controls; and residuals disposal. Various data sources provide estimates of the potential range of costs, but these “snapshots” do not necessarily provide a full accounting of the costs of intervention. In 2020, a survey administered by the DDAGW was sent to 108 PWSs (which includes 121 facilities) to facilitate a better understanding of the full range of HAB-related costs. DDAGW received 51 responses to the survey, including from 13 PWSs in the WLEB, thus serving as the primary data source for estimating the costs incurred by these PWSs. A business impact analysis (BIA) of the statewide responses to the DDAGW survey was undertaken by Ohio’s Common Sense Initiative division to estimate costs related to the enhanced HAB-monitoring requirements that took effect in 2020. The BIA is required to understand the costs associated with new or increased state regulations.

Monitoring Costs

As reported in the BIA, based on responses to the DDAGW survey, estimated statewide microcystin monitoring and cyanobacteria sample screening costs ranged from $1,000 to $100,000 annually, with an average cost of $17,313. In contrast, the DDAGW survey reported slightly higher costs for the 13 PWSs in the WLEB with an annual range of $3,000 to $100,000, and an average of $21,445. Including for estimated annual expenses associated with algae-related source water monitoring that is beyond the required compliance monitoring for microcystins and cyanobacteria screening — including staff and supply expenses (all algae-related monitoring) — increases the annual average expenses to $32,568 for the 13 PWSs in the WLEB.

Treatment Costs

Annual source water algae control (e.g., algaecide, alum, oxidants) costs for WLEB PWSs ranged from $0 to $140,000, with an average cost of $20,778 reported in the DDAGW survey. Annual in-plant algae treatment activity (e.g., ozone, powdered and/or granulated activated carbon, chemical additives) costs ranged from $0 to $750,000, with an average cost of $150,800. Note that only the City of Defiance reported costs ($15,000) related to source water protection activities in headwater areas, such as implementing nutrient runoff reduction strategies.

Residuals Disposal Costs

Cyanotoxins may be present in water treatment residuals (WTRs), which may require additional expenses for disposal. Ohio has a permitting process that allows for WTR land application as beneficial reuse on agricultural land, however, any residuals that exceed allowable concentration thresholds for microcystins or other contaminants must be landfilled. In the DDAGW survey, six WLEB systems estimated annual costs for landfill disposal, which ranged from $300 to $1 million (Toledo). Toledo noted that if all its WTRs required landfill disposal, that cost would near $3 million annually. The average annual cost — across the six WLEB systems that reported data — is $220,383 (assuming $1,000,000 for Toledo). Several systems reported "unsure" or "N/A" for residual disposal costs; if we assume those disposal costs to be $0, then the average cost is $101,715 across all 13 WLEB systems.

Capital Costs

Eight WLEB systems in the DDAGW survey reported capital costs for HAB-related plant upgrades. Capital costs for plants making upgrades for HAB compliance ranged from $35,000 to $80 million (Toledo), with an average capital cost of $14.1 million. The Toledo PWS website provides another estimate of $107 million for total HAB-related capital investments, but this analysis used the investment Toledo reported in the DDAGW survey. HAB capital expenses for Toledo total 16% of the overall completed and planned capital expenditures for plant upgrades from 2012 through 2023. To date, per-capita capital expenditures across WLEB PWSs ranged from $1.34 to $166.67. In addition, other large PWSs in the WLEB — but DDAGW survey non-respondents — also incurred HAB-related capital costs, as detailed in a 2019 USEPA publication.

Costs Per Capita

As reported by the DDAGW for the six PWSs with Lake Erie intakes, which included systems that fall outside the WLEB, the annual costs for HAB-related monitoring and treatment on a per-capita basis range from $0.48 (Ashtabula) to $31.43 (Put-In-Bay Village), with an average of $10.48. Toledo's annual per-capita costs were $18.76. These costs do not include debt service for HAB-related capital expenditures.

Conclusions

Aggregating the various operational costs of monitoring, treatment (including source protection/mitigation), and residuals disposal, the annual HAB-related costs averaged $305,862 across the 13 water systems in the WLEB represented in the DDAGW survey. These additional annual costs reported to DDAGW, as well as debt service related to HAB-related capital expenditures, are likely to drive higher costs for ratepayers. The PWS systems in the WLEB also reported a higher average likelihood of needing plant upgrades for HAB compliance within five years than did systems statewide (57% vs. 39%, respectively). In practice, this means that PWS ratepayers will likely assume all or a portion of HAB-related cost increases, with more to come as systems invest in capital upgrades. While it is likely that a disproportionate burden of future PWS costs associated with HABs remediation will likely fall on ratepayers, funding sources available from OEPA and other federal agencies to address HABs may reduce the burden on ratepayers. For example, Sandusky City received financial assistance of $2.1 million from the Drinking Water State Revolving Fund (DWSRF) to upgrade its Powdered Activated Carbon feed program. After finding microcystin levels ranging from 570 to 20,000 µg/L in its reservoir, the Bowling Green WTP received $3.35 million in DWSRF assistance and additional state funding. Importantly, DWSRF assistance is largely restricted to capital expenses, with some set-asides for operational expenses (USEPA, 2019).

OEPA's DDAGW effort to survey and compile this information should be commended. The information gleaned from the survey provides a better, albeit still incomplete, understanding of the financial impact that HABs have on municipalities and highlights the real financial burdens faced by municipalities to address HABs. Currently, DDAGW does not plan to administer additional HAB cost surveys. However, due to the highly variable annual costs associated with treating HABs (based on severity and duration of bloom growth), the Alliance believes it is critical to readminister this survey at regular intervals. We also recommend that future surveys strive for more robust data collection and expense verification with PWSs, as several of the 2020 survey respondents provided incomplete information for various cost categories. To that end, it is important to note that the costs reported to DDAGW, and consequently highlighted in this case study, cannot provide a complete picture of HAB costs in Ohio or the WLEB due to incomplete datasets.

We should note that this case study was shared with OEPA DDAGW staff. Alliance staff conservatively used the lower cost estimates for the capital expenditure and residuals disposal cost categories for Toledo because the City reported wide ranges for those cost categories. Through several conversations with the City of Toledo Collins Park Water Treatment Plant staff it became clear that the annual costs associated with addressing HABs can vary widely depending on the severity of the bloom each year. For ratepayers this means that the average cost per capita for drinking water access will almost certainly be higher in years with intense, prolonged blooms compared to more "mild" years. The fluidity of the cost per capita necessitates regular surveys of WLEB municipalities to understand the annual financial burden assumed by ratepayers.

The goal of this case study is to draw attention to the real costs assumed by downstream communities required to address HABs that continue to plague the WLEB. We hope this case study fuels new and continued discussion about whether these costs should be borne solely by the ratepayers served by these PWSs or if other funding and accountability structures should be considered to more equitably allocate the costs across all polluters in the WLEB.

References

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USEPA. (2019). *Addressing HABs and Cyanotoxins in Drinking Water with the Drinking Water State Revolving Fund*.