

Harmful Algal Bloom Community Health Project



Algal blooms are prevalent in Western Lake Erie, creating nuisance conditions and public health concerns for consumption, direct contact, and aerosolization of this water source by humans. When cyanotoxins, such as microcystin, are present in the blooms, they are commonly referred to as harmful algal blooms or HABs.

HABs caused the 2014 Toledo drinking water crisis, drawing increased media attention to this critical environmental issue. As the prevalence of algal blooms increases in other areas of the Great Lakes (e.g., Lake Huron's Saginaw Bay, Lake Michigan's Green Bay, and Lake Superior's Apostle Islands), previously unaffected areas are also potentially at risk for developing HABs. Water quality scientists and microbiologists are advancing the science of understanding HABs drivers, including predictions of spatial, temporal, and toxicity parameters of HABs. More research, however, is needed to better understand the influence of community health trends on the community-level public health risk from HABs. The project team created an online tool to visualize the intersections of water quality data, prevalence of underlying medical conditions that may result in poor outcomes from HAB exposures, and dimensions of social determinants of health at the census tract level.

ONLINE DASHBOARD

An interactive online dashboard, (bit.ly/HABSDashboard) was created to visually present data through three lenses to increase situational awareness of populations that may be vulnerable to HAB-related illnesses for five counties surrounding Western Lake Erie. Four counties were in Ohio (Lucas, Ottawa, Sandusky, and Erie), and one county was in Michigan (Monroe County) (Figure 1).

The online data dashboard displays data in three categories: sensitivity due to underlying health status, adaptive capacity if exposure to a HAB occurs, and exposure to water quality impairments. The results of this tool may inform Lake Erie community engagement efforts, such as the Great Lakes Center for Fresh Waters and Human Health in the Western Lake Erie basin. This method was also applied to Saginaw Bay to determine its usefulness for visualizing the same interactions in other Great Lakes with known areas of HABs.

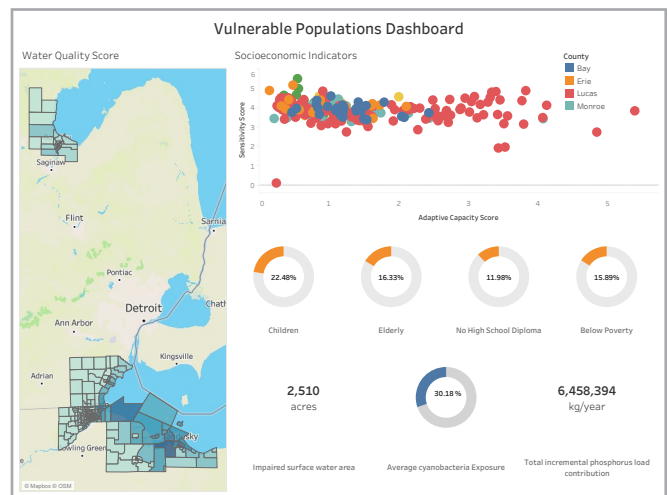


Figure 1. Overall dashboard screenshot, Western Lake Erie and Lake Huron's Saginaw Bay.

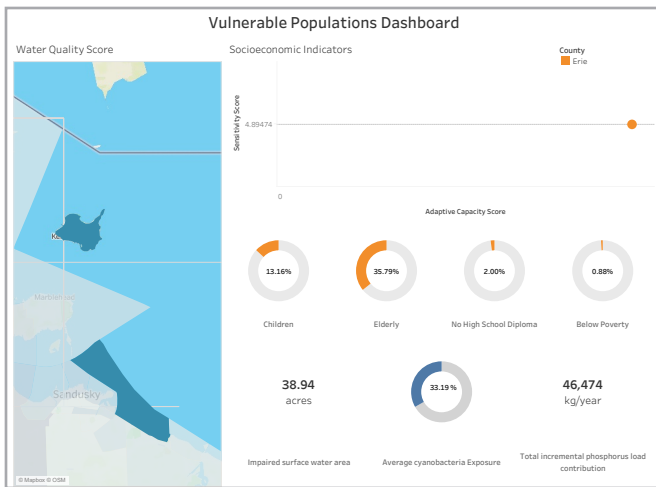


Figure 2. Example of a high sensitivity score census tract, Western Lake Erie.

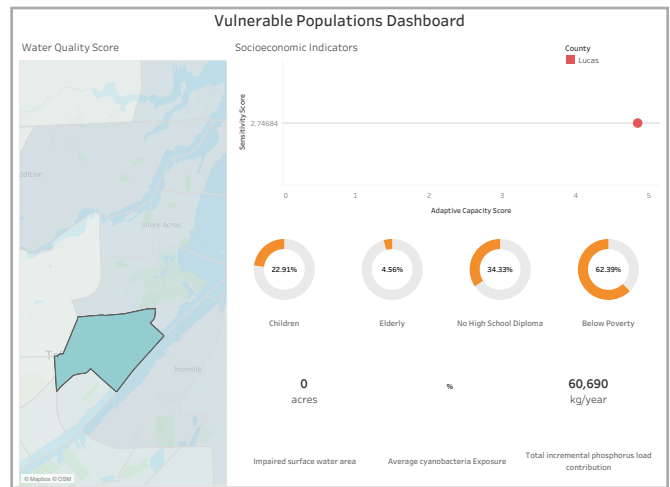


Figure 3. Example of a high adaptive capacity score census tract, Western Lake Erie.

Three overarching categories that may impact community-level health risks from HABs were used for this dashboard:

1. Sensitivity from underlying health status

The dashboard presents a sensitivity score, which represents the percentage of the total population for each census tract that is in a vulnerable category for negative health outcomes from harmful algal blooms due to underlying health status (Figure 2). This category is comprised of two dimensions: a) percentage of children under 18 years, and b) percentage of adults 65 years and older, in each census tract using the 2017 American Community Survey 5-year estimates from the U.S. census data. Younger individuals are at more risk from HABs toxins due to their water intake rates being higher relative to body weight. As a group, older individuals are at more risk, due to other underlying health conditions or weakened immune systems.

2. Adaptive capacity if exposure to a HAB occurs

The dashboard presents an adaptive capacity score, which represents the average percentage of the population 25 years and older considered more vulnerable due to poverty and/or lacking a high school diploma, ranked and normalized by county (Figure 3). These variables are proxies for an individual's available resources to potentially seek medical care for a HAB-related illness. This category is comprised of two dimensions: a) percentage of the population 25 years and older without a high school diploma, and b) percentage of the population 25 years and older below the poverty threshold using the 2017 American Community Survey 5-year estimates from the U.S. census data.

3. Exposure to water quality impairments

This category estimates the likelihood of a HAB occurring, based on a combination of data from known algal blooms and environmental conditions with the potential to cause algal blooms (Figure 4). This category is comprised of a) surface waters previously classified as impaired on the 303(d) database by the U.S. Environmental Protection Agency, b) modeled estimates of phosphorus runoff to waterbodies using the U.S. Geological Survey's SPARROW model, and c) likelihood of coastal areas to have been previously exposed to algal blooms based upon satellite imagery of algal bloom locations included in the National Oceanic and Atmospheric Administration's weekly Western Lake Erie harmful algal bloom bulletin from 2017-2019. (Note: the weekly harmful algal bloom bulletin was not available for Lake Huron's Saginaw Bay. The Bay County estimates were based only on a and b.)

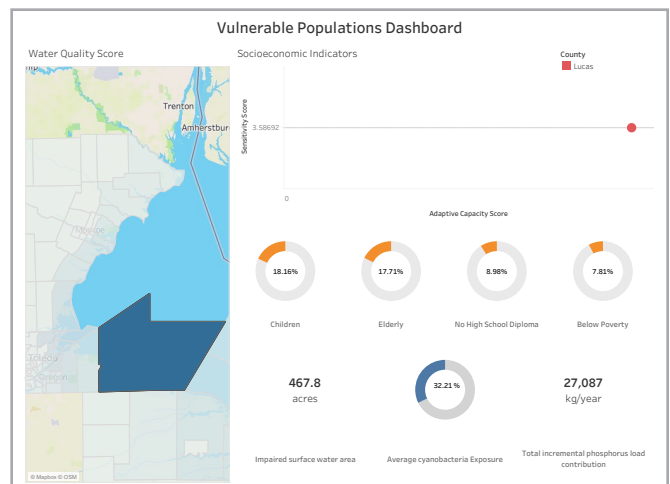


Figure 4: Example of exposure to water quality impairments, Western Lake Erie.

Why use a data dashboard? It could inform:

- Selection of sampling locations proximate to areas with higher levels of individual factors or a combination of factors, indicating where people may be at higher risk from health impacts due to HABs.
- Locations where individuals may be in need of emergency potable water supplies, should a HAB affect municipal water supplies.
- Selection of specific locations for community engagement with residents or partnerships with stakeholder organizations to address HABs and human health.
- Areas where outreach, informal educational programs, and communication campaigns may be beneficial to promote HAB-related health education programs.

Recommendations for next steps:

- Additional population-level data layers, including the prevalence of immunocompromising conditions, asthma, COPD or other chronic lung diseases, liver disease, or kidney disease, could enhance this tool by presenting specific underlying health conditions that may be severely affected by exposure to HABs.
- Additional data layers that focus on recreational anglers and other water-based recreation could quantify potential risk based on direct contact or aerosolization of cyanotoxins associated with HABs.
- Additional data layers focusing on potential risk for farm workers that may be exposed to HABs

in agricultural work through direct exposure or aerosolization of cyanotoxins associated with HABs in water supplies used for irrigation.

- Additional layers of water-service distribution areas could provide a region-wide perspective of the potential risk from contaminated drinking water, though for safety reasons these data are often protected.
- Additional GIS layers of local health department jurisdictional boundaries could help consumers better understand the complexity of public health impacts, communications, and crisis responses to multi-jurisdictional HABs.
- While this approach was successful, the National Oceanic and Atmospheric Administration harmful algal bloom bulletin is not available for areas beyond Western Lake Erie at this time. Expansion of the bulletin to other areas, or integration of satellite data from the EPA's CyAN app will increase the data available to visualize in the dashboard.

Contributing authors and reviewers: Diane Doberneck, Martha Gerig, Yusri Jamaluddin, Glenn O'Neil, Susan Peters, and Heather Triezenberg

CONTACT

Heather Triezenberg, Ph.D.

Extension Specialist and Program Leader

Michigan Sea Grant

(517) 353-5508 | vanden64@msu.edu



michiganseagrant.org/research



Acknowledgements

This fact sheet was prepared under award NA180AR4170102 from the National Oceanic and Atmospheric Administration, U.S. Department of Commerce through the Regents of the University of Michigan. The statements, findings, conclusions, and recommendations are those of the author(s) and do not necessarily reflect the views of the National Oceanic and Atmospheric Administration, U.S. Department of Commerce, or the Regents of the University of Michigan and should not be construed to represent any agency determination view or policy. This work was partially supported by funding from the NIH (1P01ES028939-01) and NSF (OCE-1840715) to the Bowling Green State University Great Lakes Center for Fresh Waters and Human Health.

MSU is an affirmative-action, equal-opportunity employer, committed to achieving excellence through a diverse workforce and inclusive culture that encourages all people to reach their full potential. Michigan State University Extension programs and materials are open to all without regard to race, color, national origin, gender, gender identity, religion, age, height, weight, disability, political beliefs, sexual orientation, marital status, family status or veteran status. Issued in furtherance of MSU Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Jeff Dwyer, Director, MSU Extension, East Lansing, MI 48824. This information is for educational purposes only. Reference to commercial products or trade names does not imply endorsement by MSU Extension or bias against those not mentioned.

Michigan Sea Grant helps to foster economic growth and protect Michigan's coastal, Great Lakes resources through education, research, and outreach. A collaborative effort of the University of Michigan and Michigan State University and its MSU Extension, Michigan Sea Grant is part of the NOAA-National Sea Grant network of 34 university-based programs.