

Human sources of fecal pollution to Lake Michigan

Widespread but hard to track

Key Message: Microorganisms associated with human waste are common in Great Lakes tributaries. The most probable source of these microorganisms is failing or improperly functioning wastewater infrastructure. Rapid monitoring tools are needed to quickly and accurately pinpoint the sources of this human health hazard.

Failing Infrastructure

Failing wastewater infrastructure is a substantial health concern in the United States. Sanitary sewers designed to convey human waste are of particular concern because they have the potential to release harmful pathogens into aquatic ecosystems when not functioning properly.

Research conducted in the Great Lakes Basin in watersheds with different land use revealed that microorganisms associated with humans are prevalent in most watersheds. A study of eight Great Lake tributaries (Figure 1) showed high concentrations of human *Bacteroides*, a microbial indicator of human waste, are present in both urban and rural watersheds. This result indicates that sanitary sewers and septic systems may be leaking into receiving waters.

The presence of human waste in urban aquatic ecosystems can occur from sewage overflows or from failures (often unrecognized) in the sewer conveyance system. Sanitary sewage can contaminate municipal separated storm sewer systems (MS4s) through illicit connections or infiltration from leaks in sanitary sewers, which are the most probable sources of sewage contamination in MS4s. The presence of human waste in agricultural watersheds could originate from both leaking septic systems in close proximity to receiving waters and from developed areas serviced by municipal sewer systems. Repairing and updating sewer infrastructure is costly, yet essential for preventing

release of human waste to receiving waters. Consequently, cost effective technologies that can identify failures within sewer systems in a timely manner are of interest to municipalities and managers.

Sniffing for Clues

Optical sensors are one technology well suited to detect sewage contamination in water, and early efforts by the US Geological Survey to develop this technology have shown promise. Optical data is validated by direct comparison to human-specific fecal indicator concentrations in a given sample. Although human-specific indicators are a robust approach to microbial source tracking, they require a laboratory and skilled personnel to measure for presence of sewage contamination, and results are not available for several days. Whereas the use of optical sensors would permit managers and field crews to perform on site investigations in real time, enabling field crews to cover more ground, as well as follow signals in a complex web of pipes in a single day.

Focusing Limited Funds

In 2008 EPA's *Clean Watersheds Needs Survey* estimated that a \$300 billion 20-year investment (\$15 billion annually) was needed to invest in aging wastewater infrastructure to address water quality or water quality related public health problems. Only 14% of that investment, or \$2.1 billion a year, was appropriated by Congress. The 2012 EPA estimate of

investment needs remained about the same at \$271 billion. Consequently, these very limited repair funds make development of a new method to quickly pinpoint sources critical and will help managers, municipalities, and other stakeholders target sewers or septic systems in most urgent need of updates. Investments in research and technology development to improve monitoring would increase the efficiency of fiscal investments made by communities.

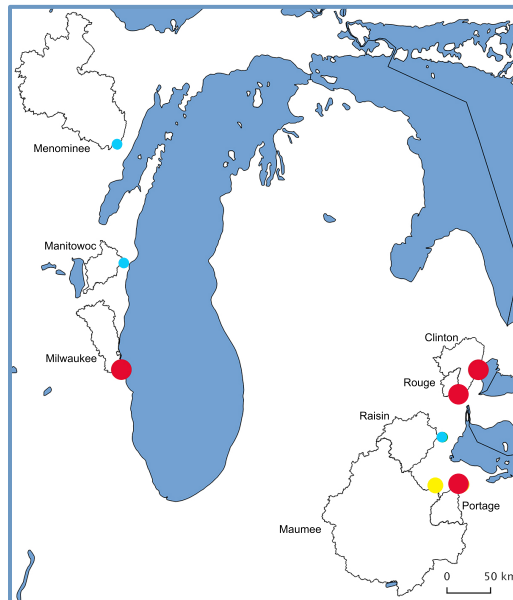


Figure 1. Eight watersheds with different land use types in the Great Lakes basin. Red=High human sewage runoff per acre, Yellow=Medium human sewage runoff per acre and Blue=Low human sewage runoff per acre.

Future Needs: Better monitoring tools are needed to detect the thousands of potential breaches in wastewater infrastructure. Human-specific fecal indicators can be used to validate optical sensor technology under development by USGS.

What is the Science/Implementation Gap?

- Further studies to develop sensors that accurately pinpoint sanitary sewer and septic failures
- Outreach to municipalities to adopt sensor technology
- Investment in monitoring programs to use new methods and technology

Additional Reading

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