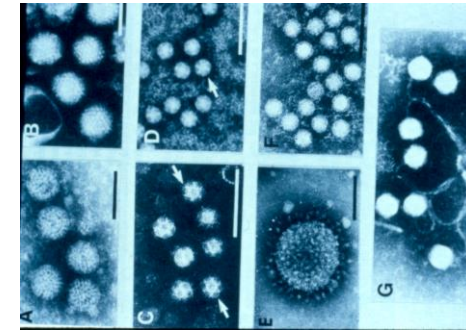


Public Health Issues Associated with Septic Tanks

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Septic Tanks as Sources of Human Viral Pathogens



Environmental Health-Related Viruses Infecting Humans

- Adenovirus
- Coxsackievirus
- Echovirus
- Enteroviruses
- Hepatitis A and E
- Norovirus
- Poliovirus
- Rotavirus

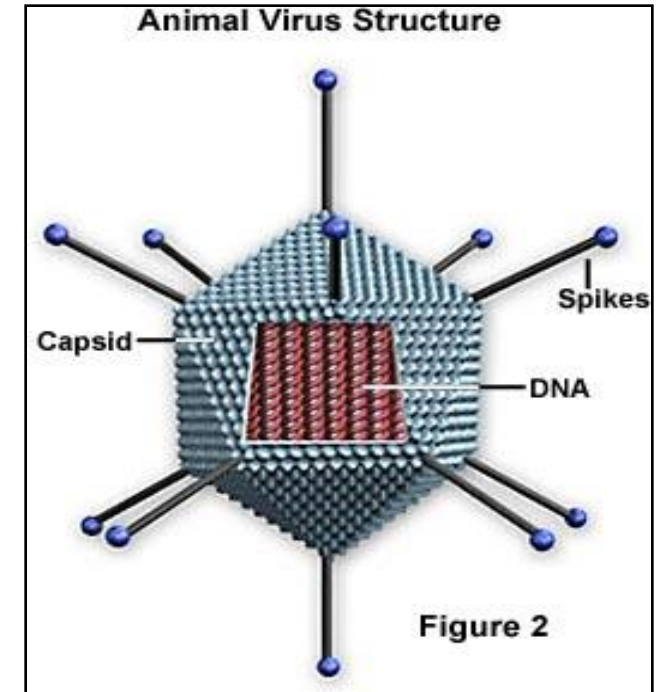


Bacteriophage are viruses that infect bacteria, associated with moving virulence; antibiotic resistance genes, controlling bacterial populations

OVER 100 different viruses are found in sewage: Adenoviruses, respiratory and enteric viruses, higher numbers, greater resistance to wastewater treatment. Coxsackie viruses cause myocarditis and viral meningitis. Identification of cancer causing viruses (Polyomaviruses) in Wastewater.

Viruses

- Extremely small biological nano particles
- Persistent
- Excreted in high concentrations
- Obligate parasites, need a host to replicate
- Generally very host-specific
- Simple structure, RNA or DNA, surrounded by protein coat and some containing lipids and other glycoproteins.



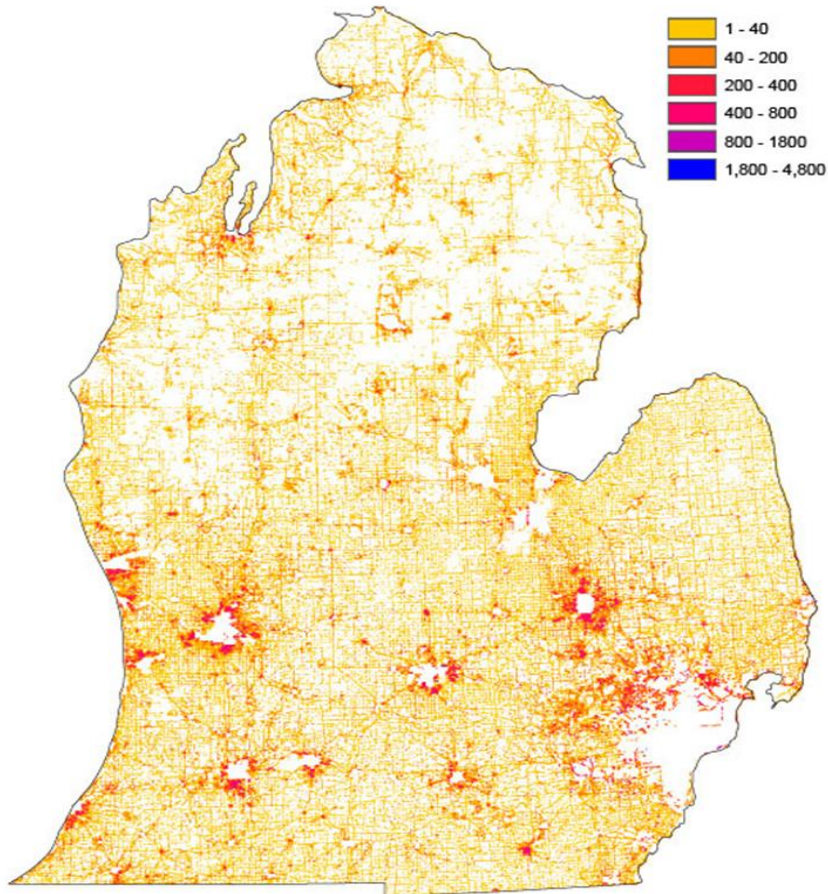
Studies in Wisconsin have shown statistical Association between diarrhea in children and Virus infection and Septic tank density.

- No evidence of well contamination based on coliforms indicators
- Virus infections associated in a 640-acre section
- Bacterial infections in a 40-acre section.
- Unknown infections associated with Enterococci contamination

Borchardt et al. May 2003 *Envir. Hlth Perspec* vol 111

Wastewater in Michigan

- Approximately 30 percent of Michiganders are on septic



Septic system density

Aging, failing septic systems polluting Michigan waters, harming public health



Keith Matheny

Detroit Free Press

Published 6:30 a.m. ET Oct. 14, 2021 | Updated 4:32 p.m. ET Oct. 16, 2021

As Susan Daly closed in on purchasing her next home earlier this summer — a cottage on a hill built in the 1920s in Oakland County's Highland Township — a home inspector's discovery of an unusual pipe configuration turned what is often a routine home inspection at property closing time into an examination of the home's septic system.

- The Michigan Department of Environment, Great Lakes and Energy (EGLE) estimates that **about 10%** of the state's septic systems are failing, releasing bacterial pathogens and unwanted chemicals into groundwater and surface water — 31 million gallons of raw sewage per day. Oct 14, 2021

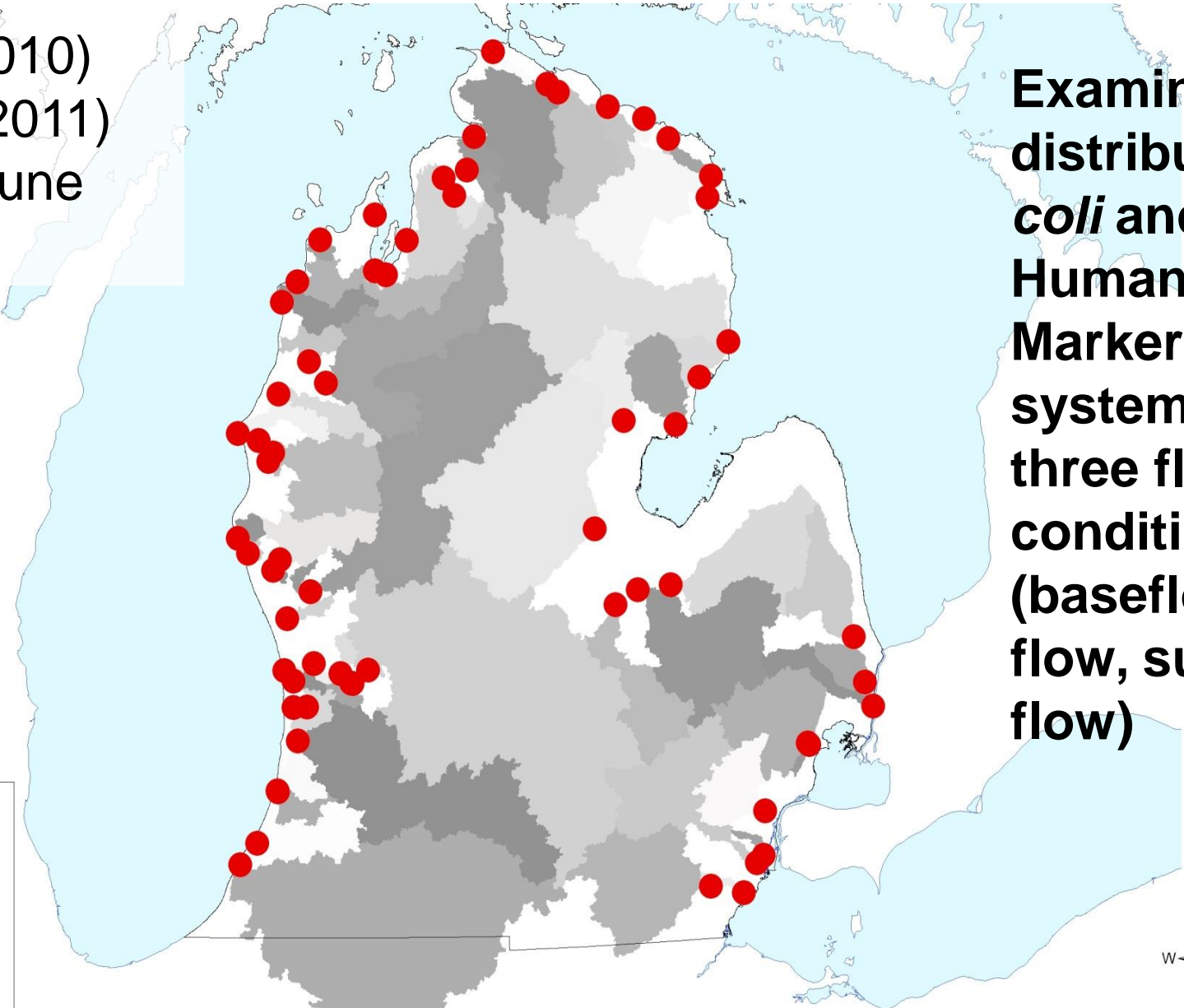
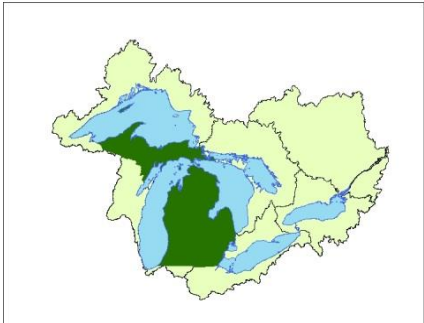
Large Landscape Assessment using Human Fecal Source Tracking Marker

Baseflow (October 2010)
Spring thaw (March 2011)
Early summer rain (June 2011)

64 River systems

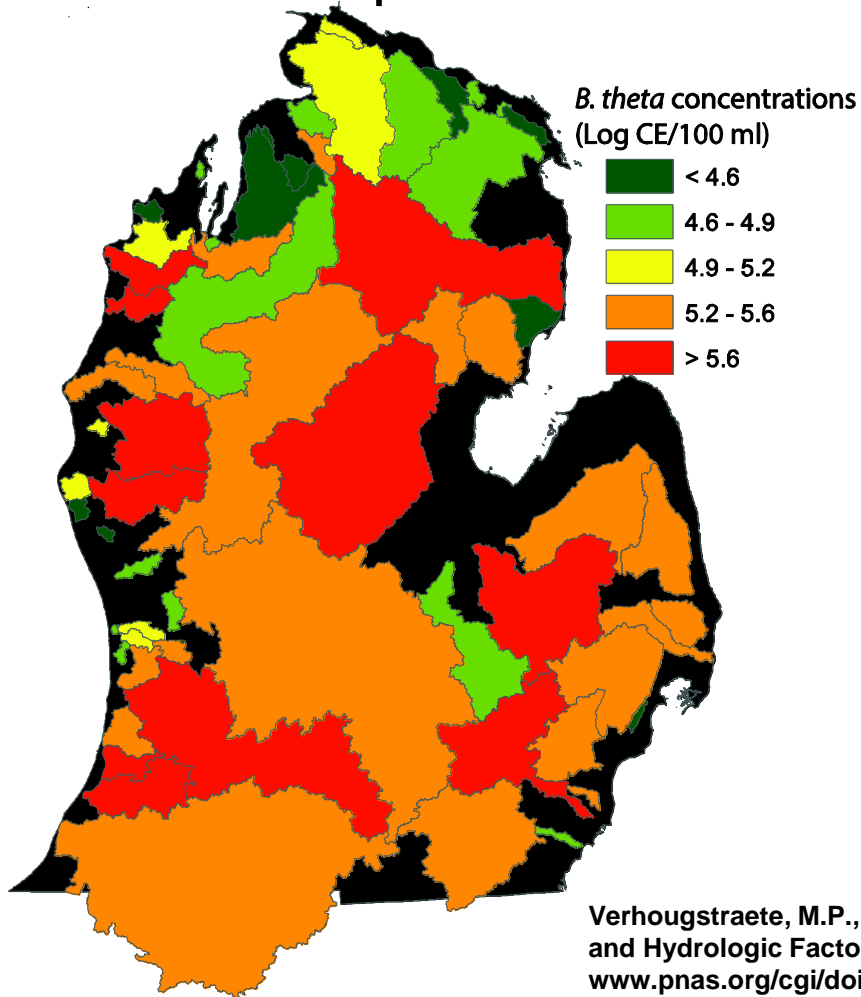
84% Lower Peninsula drainage area

Examined spatial distribution of *E. coli* and *B. theta*, Human fecal Marker in river systems under three flow conditions (baseflow, spring flow, summer flow)

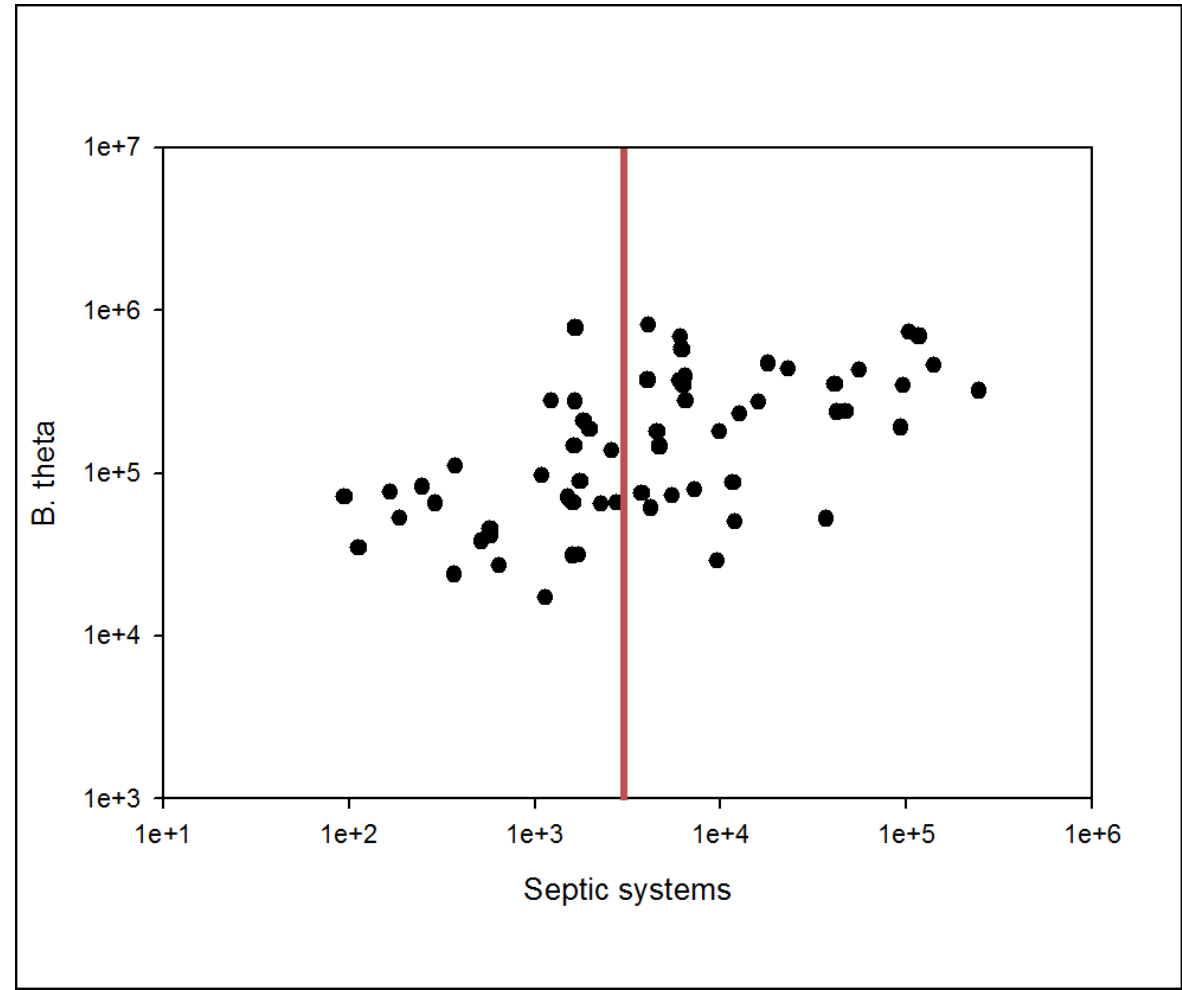


0 25 50 100 Kilometers

- Increasing *B. theta* related to more septic tanks
- *More E.coli* related to more total phosphorous and increasing stream temperature



Finding: The distribution of the human sewage marker *Bacteroides*



Verhougstraete, M.P., Martin, S.L., Kendall, A.D., Hyndman, D.W. and Rose, J.B. 2015 Linking Fecal Bacteria in Rivers to Landscape, Geochemical, and Hydrologic Factors and Sources at The Basin Scale. *Proceedings of the National Academy of Sciences*. www.pnas.org/cgi/doi/10.1073/pnas.1415836112, pages1-6.

What did we learn?

- New microbial source-tracking tools elucidate important nonpoint sources of water quality degradation and potential need for further investigation of human health risks at large scales
- Pollution arising from septic system discharges likely more important than previously realized
- **NEED for MONITORING:** Without a way to monitor our onsite wastewater systems we will not be able to protect the quality of our waters from viruses. We will not be able to know where we need to modernize our wastewater infrastructure for our rural communities.

Thank You!

Any Questions??

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