Project Summary for DNR Project #222

Meeting the Source Assessment Requirement under the RTCR: A Wisconsin Pilot Project

When evaluated in 2010, the EPA estimated that 10.5 million people in the United States rely on potable ground water from small water systems known as transient non-community water systems (TNCWS). Under the Safe Drinking Water Act, these systems are required to monitor for total coliforms under the Revised Total Coliform Rule (RTCR) but are not required to provide treatment except under certain circumstances. The risk for microbial contamination in TNCWS is especially high as many provide untreated water and are often located in rural areas which can be susceptible to contamination from human activities including septic systems and animal agriculture. One unsafe monitoring sample from a TNCWS can lead to time consuming and financially burdensome follow-up testing and assessments, and forcing increased future routine monitoring. The burden is especially onerous in Wisconsin as there are over 9,000 TNCWS, which is believed to be the highest number in any single state. This research project focuses on developing and evaluating an alternative RTCR unsafe follow-up assessment program for use by the Wisconsin Department of Natural Resources (WDNR) to meet the source assessment requirements for total coliform unsafe wells under the RTCR. The program focuses on integrating components including:

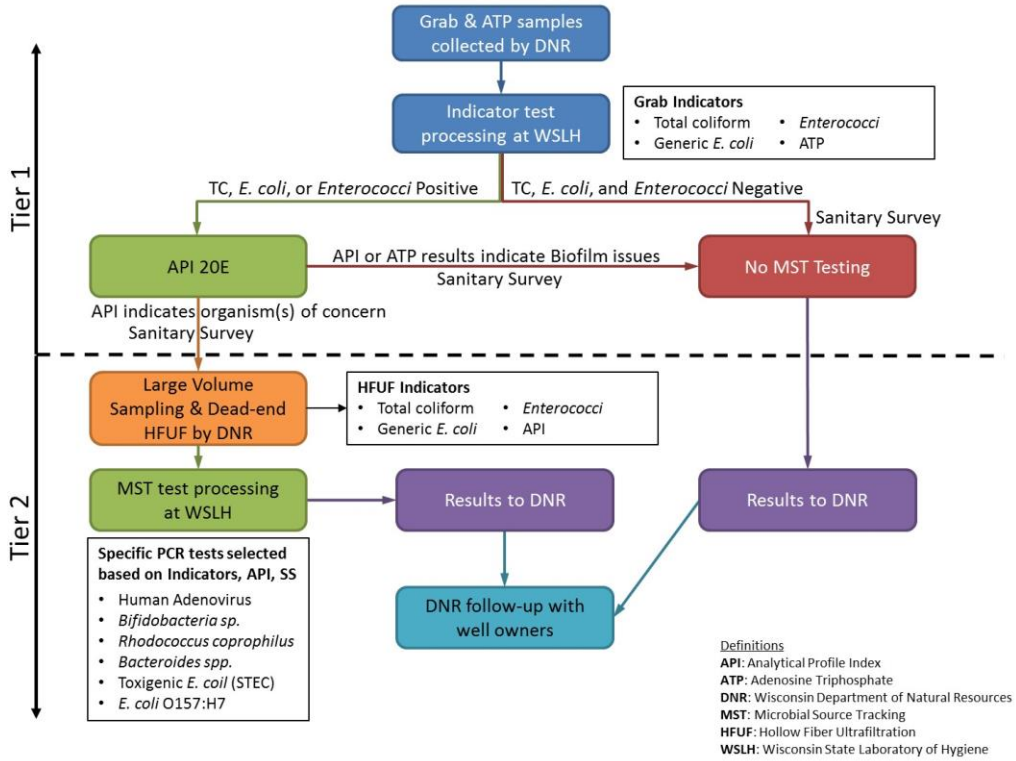
- large volume sampling (100L of well water),
- hollow fiber ultra-filtration concentration of that sample,
- measurement of microbial indicators (total coliforms, *E. coli*, and enterococci),
- ATP measurements,
- enterobacteria identification,
- molecular testing (qPCR) for fecal source tracking (FST) targets,
- and land use information.

The real goal of this follow-up assessment is to inform well owners of the potential for microbiological contamination and identify the likely source(s). The above assessment components allow the DNR staff to develop recommendations to well owners based on the analytical results. The general conclusion from routine testing and sampling identified that many TNCWS were contaminated by biofilms which contained environmental coliforms triggering RTCR monitoring unsafes. For wells determined to have biofilm issues, sanitizing followed by modifications in well operation and maintenance are the preferred corrective action. Additional project conclusions are highlighted below:

- A suite of bacterial indicators should include total coliforms, *E. coli*, and enterococci. The sanitary significance of these indicators should be assessed at a 1.0 MPN/100mL threshold (*i.e.* a value $\geq$ 1.0 MPN/100mL)
- The addition of ATP quantification using a time-series collection method allows for assessment of potential biofilm issues associated with either well infrastructure or the aquifer.
- The molecular source tracking tests most suitable for use in Wisconsin include human *Bacteroides*, *Rhodococcus coprophilus*, and human adenovirus. Additional tracking test

such as ruminant *Bacteroides* and toxigenic *E. coli* strains should be used strategically in cases where historic or recent evidence may warrant their use.

- Large volume sample collection and concentration is key to detection of molecular source tracking indicators which can be dilute in the environment.
- The human *Bifidobacteria* assay is likely not appropriate for application in Wisconsin and should be removed from the suite of molecular indicators.
- Land use and system information from a project-specific sanitary survey adds useful evidence as part the weight-of-evidence approach to determine potential sources of fecal contamination.
- Using a screening method consisting of bacterial indicators, bacterial identification, and sanitary survey information can predict the presence or absence of molecular source tracking targets with approximately 60% accuracy. If cases where screening was more conservative are considered (*i.e.* where screening. suggested fecal contamination when not detected with molecular methods), the developed methodology can provide a level of public health protection at approximately 95% confidence.
- A two tiered project workflow, presented in the figure below, utilizing a screening method to separate those wells with biofilm issues from those with indications of fecal contamination allow for decreased field sampling time by WDNR staff (fewer large volume samples) and overall reduced costs associated with maintaining large volume sampling supplies and conducting molecular source tracking tests.



Overall, this methodology is designed to accurately, cost-effectively, and quickly assess microbiological contamination in TNCWS and provide a long-term solution that is sustainable, holistic, and economical for the WDNR and each public water supply investigated.