

## COMPLETION NOTICE

### SA ¶ 4(d) Study various parameters that affect performance of qPCR signal for enterococci and compare with other methods and pathogens in treated wastewater mixed with ambient waters (enterococci, *E. coli*, *Cryptosporidium*, and enterovirus) (P8)

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#### Summary of the Study

The goals for this study were to evaluate the *Enterococcus* qPCR signal during wastewater treatment, after release into the environment and the relationship of the *Enterococcus* qPCR signal to other fecal indicators and pathogens. The study evaluated the fate of enterococci, *E. coli*, and F-specific (F+) coliphage, as well as specific pathogens (enterovirus, *Cryptosporidium* and *Giardia*), through wastewater treatment.

Wastewater samples were collected from the following Hamilton County Metropolitan Sewer District wastewater treatment plants (WTP) in Cincinnati, Ohio: Mill Creek WTP (activated sludge treatment with chlorine disinfection); Little Miami WTP (activated sludge treatment with chlorine disinfection); Muddy Creek WTP (activated sludge treatment with UV disinfection); and Polk Run WTP (activated sludge treatment with UV disinfection except in winter). Samples were collected at four different locations at each WTP: raw sewage influent, primary effluent, secondary effluent before disinfection; and secondary effluent after disinfection by either chlorination or UV disinfection, but before the effluent was discharged to the receiving streams. A preliminary dry run was conducted on March 23–26, 2009. The spring, summer, and winter seasonal sampling visits were conducted on May 27, 2009–June 5, 2009; September 8–16, 2009; and December 8–16, 2009, respectively.

In addition, the decay of the fecal indicators and pathogens after treatment was examined after mixing wastewater effluents with surface water under laboratory conditions. This additional research, using mixtures of discharged wastewater ambient river water, used: secondary effluent after disinfection but before discharge into ambient water; 5% secondary effluent after disinfection mixed with 95% Ohio River water; and 20% secondary effluent after disinfection mixed with 60% partially-treated drinking water and 20% Ohio River water. The ambient Ohio River water samples were collected and partially-treated drinking water samples (Ohio River source water) were collected at the Greater Cincinnati Water Works after sand filtration, but before activated carbon treatment.

#### Summary of Findings

The summary of results from this study are:

- The reduction in levels of *Enterococcus*, as measured by both qPCR and culture, was similar during primary and secondary treatment.
- After chlorine and UV disinfection, Enterococci qPCR levels persisted more than culture. Similar patterns were observed between the *Enterococcus* qPCR and *Escherichia coli* culture methods. The differences were less pronounced for *Enterococcus* qPCR comparisons with F+ male-specific coliphage, *Bacteroides*, and *Clostridium perfringens* culture methods.

- Both qPCR and culture measurements degraded at similar rates in discharged treated wastewater effluents. Reductions of fecal indicator densities were lowest in the winter.
- Pathogens were not found consistently or at sufficient levels to assess persistence.

**This study has been completed as of December 15, 2010.**