Real-Time *E.coli* Monitoring with the LiquID Station

April 2012

Dairy Waste in the Creek

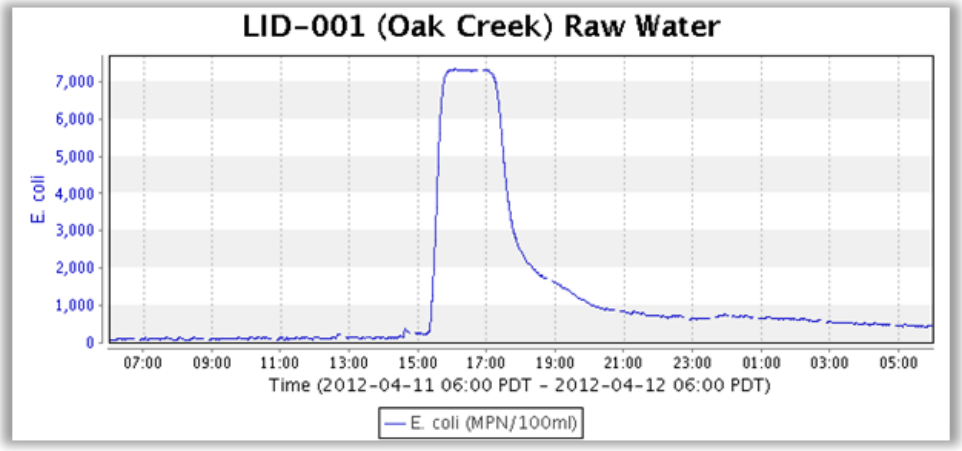
The LiquID Station monitors animal-waste contamination events in the Oak Creek basin.

On the afternoon of April 11th, 2012, local residents living near Oak Creek in Corvallis, Oregon noticed a strange and unpleasant smell coming from the creek and called the city's Public Works Department. The source of the contamination was traced back to the dairy farm at the local university, where an irrigation pipe carrying a manure and water mixture to pasture land had ruptured. The problem was eventually fixed, but not until the broken pipe had pumped sewage into the creek undetected for a couple of hours.

As part of a research and demonstration project, ZAPS Technologies has installed a LiquID Station on Oak Creek, downstream of the dairy farm and other agricultural activities, for continuous online water-quality monitoring.

Real-time detection of contamination

The LiquID Station on Oak Creek detected the leak immediately. The graph to the left shows real-time measurement of E.coli from LiquID's online web user interface. There are frequently small *E. coli* events in Oak creek of a few hundred units, , but the manure leak showed up as a sharp distinct and much larger peak than normal. When the leak was repaired after about two hours, *E.coli* levels rapidly fell off, although notably they did not go back to baseline as residual manure continued to leach bacterial contamination into the creek over time.



LiquID Optical Monitoring Principle for *E.coli*

The capability to monitor *E.coli* in a surface water stream in real-time provides a powerful indicator of

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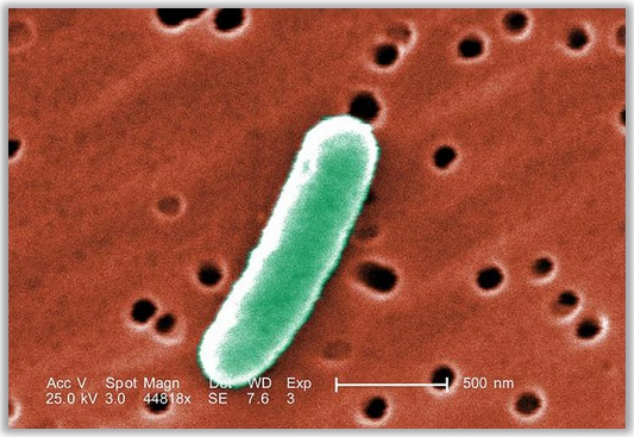
contamination from animal wastes or sewage leaks and enables active source water protection. LiquID accomplishes this feat by utilizing its unique *hybrid-multi -spectral* design, combining UV-Vis absorbance spectroscopy with fluorescence measurement.

Basically … fecal bacteria are natively fluorescent, primarily from the amino acid tryptophan, which is one of the building blocks of life that is highly prominent in *E. coli* cells. LiquID uses its hybrid-fluorescence monitoring capability to sensitively and selectively detect bacterial tryptophan protein, providing a powerful indicator of fecal contamination. Absorbance spectroscopy is used to sort through interferences and apply correction factors, providing users with a clear and quantifiable signal that is calibrated to report in units of *E.coli* Most Probable Number (MPN).



A micrograph of a single E.coli cell. These bacteria produce high levels of fluorescent protein, which is detectible with LiquID.

The LiquID Hybrid-Multispectral Contaminant Warning System

The unique hybrid-hyperspectral design of the LiquID Station allows the machine to "see" like no other instrument can see. Both absorbance and fluorescence measurement techniques have their strengths, and LiquID utilizes both of those, providing unmatched breadth of detection for different classes of compounds.

Fecal contaminants are just one of those classes. The system also includes hybrid-optical measurements for the detection of other key surface water contaminants such: algal pigments for detection and typing of blooms, refined hydrocarbon fluorescence from urban runoff, and a measurement called fluorescent dissolved organic matter (FDOM) that is highly sensitive to certain artificial organic compounds such as pesticides.

The LiquID Station equipped with the Drinking Water & Environmental (DWE) Monitoring build provides all of these uncommon measurements as well as more classic water quality measures including total organic carbon, UV absorbance, specific UV absorbance, nitrate, color, and turbidity. All of these are provided on an automated basis about every two minutes, for effectively continuous online monitoring, from a system that is all optical, uses no reagents, and includes self-cleaning and self-calibrating systems. At ZAPS, we like to say "just add water".

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