



Remote Sampling Technology: Proactive Management of Surface Water and Development of Comprehensive Data Sets for "Early Warning" Applications

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Biographical Sketch of Author

Mr. Owen is Founder, President and Chief Operations/Technical Officer for Apprise Technologies, Inc. Apprise is a measurement and control company producing opto-electronic, data acquisition and telemetry systems. Prior to founding Apprise, Mr. Owen was with the University of Minnesota as a Research Associate, where he was issued 10 patents related to sensor development and environmental monitoring and published extensively in peer reviewed journals in the fields of optical physics, aquatic toxicology, limnology, fresh water chemistry, and biology. Mr. Owen recently presented to committee members of the US Congress and Senate on near-term solutions for an early warning system to protect vulnerable surface water resources.

Abstract

New advances in technology for obtaining high-resolution vertical chemical and biological characterization of reservoir water quality parameters has demonstrated significant savings in the operation costs of drinking water treatment plant operations as well as obtaining time relevant, date of in-reservoir dynamics which are critical for protection of human health. The Remote Underwater Sampling Station (RUSS) technology has been used successfully to monitor a number of critical parameters, important to managers and operators. At the core of this technology is the RUSS Dynamic Profiler. The Dynamic Profiler moves up and down the water column using variable buoyancy and carries a suite of sensors to measure the parameters of specific interest to the customer. Movement of the profiler, data acquisition and data retrieval are remotely controlled by the customer using the embedded CPU, which controls the Dynamic Profiler movement, data acquisition, and telemetry functions on the buoy platform.

The system has been used for early identification of turbidity plumes and algal blooms that would have not been identified by standard infrequent sampling programs, integrated with time-of-travel models for predictive assessment in process control management. In addition, the effects of watershed events, such as rainfall events and watershed disturbances due to such activity as construction, may be monitored remotely by operators and managers 24 hours a day, 7 days a week throughout the entire water column. The system has been used to monitor suites of chemical and biological parameters simultaneously, delivering a single sensor package to user programmed depths, including Dissolved Oxygen, pH, Conductivity, Temperature, Redox, Turbidity, Chlorophyll, Cl₂, Light Attenuation and Total Dissolved Gas. Surface sensors integrated into the system have included metrological stations measuring wind speed and direction, barometric pressure, air temperature, relative humidity and surface light and current profiler (ADCP) systems.

As a result of recent events, risks to water infrastructure been broadened to include not only natural or accidental events but also malevolent activities. These types of risks may be high-tech



or low-tech, may be executed by organized groups or loose networks and may include exotic or common chemical or biological agents, the results of which may be widespread panic, significant economic impact, and loss of public confidence in the US water supply infrastructure. In order for an in-situ monitoring system to be effective in this application, according to a recent report to the US House of Representatives, they must include the following: Provide Warning in Sufficient Time for Action; Integration of Multiple Sensors in a Modular or Expandable Installation; Affordable; Can Be Mass Produced; Requires Low Skill and Training to Operate; Covers ALL Potential Threats; Gives Minimal False Positive and Negative Responses; Robust, Reproducible, and Verifiable; Allows Remote Operation; Functions Year-Around; Turns Data Into Knowledge and Can be Networked or Installed in Multiple Locations.

The RUSS system, coupled with models and data visualization tools, is currently teamed with off the shelf water quality, metrological, and flow sensors to create a "canary in a coal mine" approach to monitoring, meeting most of the objectives set forward to the House and allowing for broad spectrum sensitivity to chemical and biological agents, monitoring system response rather than the development of an enormous number of sensors specific to all the possible agents.

Operators are not only using this data as an early warning system, but also to validate and verify management models. Pilot studies are currently installed for use of this system as an Early Warning System for reservoir managers, examples of which will be discussed. In addition, case studies of the application of RUSS technology will be presented.

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Selected Publications:

Effler, S.W., C.J. Owen. The use of robotics automatic profiling systems to estimate primary productivity in a polluted lake. Submitted to Restoration Engineering (October 2001).