Technology Transfer Opportunities: Automated Ground-Water Monitoring, A Proven Technology

Introduction

The U.S. Geological Survey (USGS) has developed and tested an automated ground-water monitoring system that measures and records values of selected water-quality properties and constituents using protocols approved for manual sampling. Prototypes using the automated process have demonstrated the ability to increase the quantity and quality of data collected and have shown the potential for reducing labor and material costs for ground-water quality data collection. Automated ground-water monitoring systems can be used to monitor known or potential contaminant sites, such as near landfills, underground storage tanks, or other facilities where potential contaminants are stored, to serve as early warning systems monitoring ground-water quality near public water-supply wells, and for ground-water quality research.

About the Invention

The automated monitoring process is designed to: follow proven ground-water sampling protocols, provide reliable data indicating ground-water quality, regulate its own performance through system feedback, and communicate data and system performance through remote communications. A record of relatively frequent measurements of water-quality properties and(or) constituents collected at a monitoring site can indicate when ground-water quality is changing and can provide a context for the interpretation of laboratory data from periodic discrete samples. The process is designed to monitor and record water-quality properties and constituents in water pumped from the well or multilevel sampler until purge criteria have been met. The automated monitoring process utilizes feedback to monitor the status of the system and to record and communicate problems if an error is detected. The ability of the automated system to respond to or initiate communications allows human operators to check the system or monitor ground-water quality from a remote site without costly field visits.

Proven Technology

The U.S. Geological Survey has been operating a series of prototypes to develop and test the automated ground-water monitoring technology since 1995. The first prototype demonstrated that the process was feasible for monitoring in standard wells. The second prototype demonstrated that the process was feasible for monitoring several ports of a multilevel sampler. The third prototype was tested in 1996, and sufficient quality assurance/quality control data were collected to demonstrate that the data obtained by the automated method was equivalent to data obtained by manual sampling methods using the same protocols.

The fourth and fifth prototypes were designed as technology demonstration units. Both units were deployed in conjunction with existing projects at high-profile sites. The fourth prototype was installed downgradient from an innovative in-situ remeidiation technology described as a reactive wall. The forth prototype was successful in that it recorded substantial changes in ground-water quality in a short time period (fig. 1), and it automatically notified the project chief that measurements had exceeded preestablished ground-water quality criteria. The fifth prototype was installed at Walden Pond in Massachusetts at a location that is downgradient of the State Park's septic-system leach field. This system has been successfully documenting the quality of ground water at this location, information that will be useful in assessing the septic system as one of the potential sources of nutrients that may be causing eutrophication of the pond.

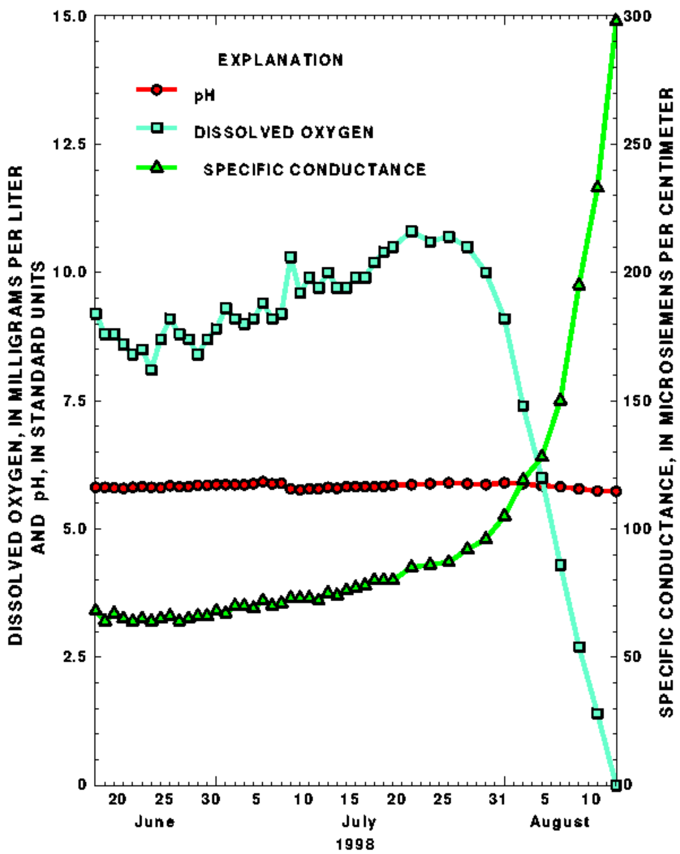

Figure 1. Ground-water quality measured by the automated monitoring process in well SDW 485-0102A, downgradient of the reactive wall, Cape Cod Massachusetts.

Advantages Over the State-of-the-Art

Historically, automated ground-water quality monitoring has been done using passive monitoring devices. These passive-monitoring devices use a data logger to control a water-quality monitoring probe (or probes) suspended in a well to collect ambient data at a preset frequency. Passive methods require less infrastructure, manpower, and maintenance than either our active automated monitoring process or traditional manual sampling methods.

Passive monitoring methods, however, have significant limitations that do not apply to our active system. The size of the passive monitoring-instrument selected determines the minimum diameter and screened interval of the well that may be sampled. It is generally recognized that the composition of water within a well and in close proximity to the well is probably not representative of surrounding groundwater quality at a sampling site. Also, wells that screen more than one zone of a physically or chemically heterogeneous aquifer can act as conduits for natural or induced flows between different zones screened by the wellbore. Therefore, measurements made by passive monitoring devices emplaced in a well may not represent surrounding ground-water quality.

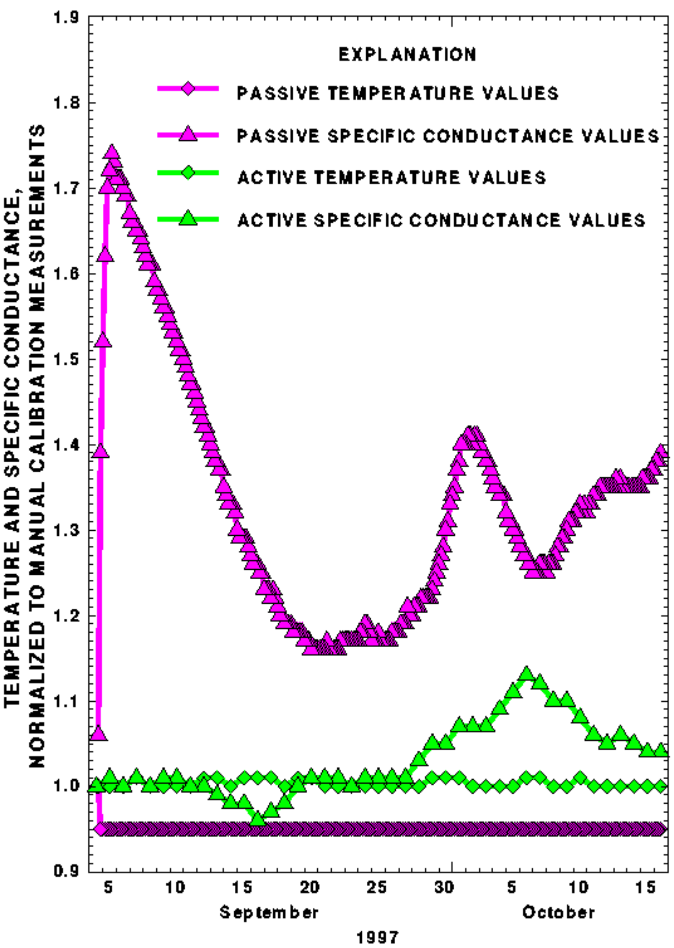

Figure 2. Normalized measurements of ground-water temperature and specific conductance by active and passive automated monitoring systems in wells SDW-0028 and SDW-0028A respectively.

The USGS did an experiment to compare passive and active-automated methods in a pair of short-screened wells located immediately downgradient from a source of ground-water contamination. Identical probes, which were fully functional, calibrated and operating within design ranges throughout the experiment, were used in both the active and passive monitoring devices. The data obtained from the two methods were normalized using manual measurements made in each respective well at the beginning and end of each monitoring period (fig. 2). Data were normalized for direct comparison to the manual sampling data and for direct comparison between data from each well and method. The active system, which pumped and purged the well once a day, provided data that correlated closely with the manual sampling data. The passive system, which activated probes in the adjacent wellbore every two hours, was clearly affected by natural flows of water in the wellbore from a zone that was not typical of the average water quality in the screened interval. This was evidenced by the rapid change in specific conductance measurements when the probe was emplaced after manual sampling at the beginning of the interval and the 40 percent difference between the final passive measurement and the subsequent manual specific conductance measurement.

Patent Status

A patent application has been submitted on this process and apparatus. It is now available for licensing.

For More Information

For more information about licensing of this and other patents and for cooperative research opportunities with the USGS please contact:

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