Water 2050: Challenges and Opportunities in Drinking Water Infrastructure

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Water is a central actor in our engineered systems for food production, energy generation, and water and wastewater management. Global changes in water availability and quality, driven by population growth, increasing urbanization of populations, industrialization and economic development, and climate change will produce new challenges in our management of water.

In particular, drinking water systems have developed and been deployed without sufficient attention to issues of robustness, security and sustainability. New advances in cyberinfrastructure (sensing, computing, data management) will play a significant role in transitioning existing water infrastructure to a more integrated long-term management system that is critical as we move into a century expected to be marked by the challenges describe above. Two aspects of the current digital revolution make this vision possible. First, improved sensing systems will enable more individualized water treatment, tailoring the systems used to the quality of the source water in semi-real time. Second, improved sensing within the distributed infrastructure coupled to data management enables identification of compromised infrastructure and real-time response to problems. Intentional contamination events will be detected and removed from the system before widespread consumption of tainted water.

This vision requires development of technology and understanding across multiple dimensions. Improved modeling of the hydraulics and water quality aspects of drinking water distribution systems is needed. Improved and lower-cost water quality sensors for a wide variety of system parameters and potential chemical and biological agents are needed. Understanding the data sent by new sensors and how it can be used to identify threats, locate sources of contamination or of system failure, and respond appropriately will require improvements in data mining, database structures, and data uncertainty analysis. Integration of real-time streaming sensor-based data with operational control systems will require a complete redevelopment of computing systems for drinking water plants.

This talk will emphasize the technical challenges and current approaches, with particular emphasis on the work of my research group optimizing the deployment of sensors, understanding chlorine sensor limitations, developing bacterial indicator sensors, and responding to threats with chlorine booster systems.

Dr. VanBriesen received her B.S. in secondary education and chemistry from Northwestern University. She received her M.S. and Ph.D. in Civil Engineering from Northwestern University. She is currently a Professor in the Department of Civil and Environmental Engineering at Carnegie Mellon University with a courtesy appointment in the Department of Biomedical Engineering. She recently served on the National Research Council study on water quality in southwestern Pennsylvania (http://www.nap.edu/catalog/11196.html) and was named director of an urban water quality center launched at Carnegie Mellon in 2005 (http://www.ce.cmu.edu/~wquest/). Her research interests include biogeochemistry of recalcitrant organics (including chelates and PCBs), thermodynamic analysis of biological systems, and detection and quantification of pathogenic organisms in natural and engineered water systems. http://www.ce.cmu.edu/~jeanne/