Seminar by,

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Moving Beyond Resilience by Considering Antifragility in Potable Water Systems

Abstract: It is inherently difficult to plan water systems for a future that is non-predictive. This presentation introduces a novel perspective for the design and operation of potable water systems under increasing water quality volatility (e.g., a relatively rapid and unpredicted deviation from baseline water quality). Increased water quality volatility and deep uncertainty stress water systems, confound design decisions, and increase the risk of decreased water system performance. Recent emphasis on resilience in drinking water treatment has partly addressed this issue, but still establishes an adversarial relationship with change. An antifragile system benefits from volatile change. By incorporating antifragility, water systems may move beyond resilience and improve performance with extreme events and other changes, rather than survive, or fail and quickly recover. Using examples of algal blooms, wildfires, and the COVID-19 pandemic, this presentation illustrates fragility, resilience, and antifragility within physicochemical process design including clarification, adsorption and disinfection. Methods for increasing antifragility, both individual process options and new system design tools, will be discussed. Novel physicochemical processes with antifragile characteristics include ferrate preoxidation and magnetic iron (nano)particles. New design tools that allow for systematic evaluation of antifragile opportunities include artificial neural networks and virtual jar or pilot "stress testing". Incorporating antifragile characteristics represents a trade-off with capital and/or operating cost. The presentation contains a real options analysis approach to considering costs in the context of antifragile design decisions. Adopting this antifragile perspective will help ensure water system improved performance during extreme events and a general increase in volatility.

Biosketch: Joe Goodwill is currently an Assistant Professor in the Civil and Environmental Engineering Department in the College of Engineering at the University of Rhode Island, a position he started in the fall of 2017. In this appointment he executes research in physical-chemical processes, water quality, and water poverty issues. He also teaches classes focused on water treatment and reuse, and environmental analytical techniques. His Ph.D. and M.S. degrees in Civil Engineering are from the University of Massachusetts Amherst. He also holds a B.S. in Civil Engineering from Lafayette College. Prior to entering academia, Joe was a Project Engineer for Black & Veatch working on global projects out of their Philadelphia office. He is a licensed Professional Engineer (PE), and a Leadership in Energy and Environmental Design (LEED) Accredited Professional. Joe also works with multiple international water NGOs, supporting projects in Malawi, India, Ghana, and Bolivia. He received an NSF Faculty Early Career Development Award in 2021.

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