Boindala Sriman Pankaj, G. Jaykrishnan and Avi Ostfeld, 2022, Optimizing water quality treatment levels for water distribution systems under mixing uncertainty at junctions, *Journal of Water Resources Planning and Management,* Volume 148, Issue 5, May 2022, DOI: 10.1061/(ASCE)WR.1943-5452.0001544.

Abstract A real-life water distribution system (WDS) contains uncertainty in numerous stages. This makes the optimal management and design of a WDS a complex problem. Water quality has also become a significant factor in the design and management of a WDS. Our objective was to incorporate water quality uncertainty in the WDS design problem. The mixing level was assumed to be uncertain and used to design the WDS such that the design was immune to the level of mixing. This method aimed to yield designs that satisfied the nodal concentration constraints irrespective of the mixing level in the junctions. Two optimization methodologies, robust optimization and info-gap decision theory combined with a cuckoo search optimization algorithm, were proposed to solve this problem. An illustrative example 4×4 grid network was used to understand nonuniform mixing and explain the design methodology using both methodologies. Then these methodologies were applied to solve a similar treatment plant problem on a modified Fossolo network. The results also exhibited a significant variation in cost between complete mixing and nonuniform mixing. The WDS designs obtained from both methods were evaluated through Monte Carlo simulations.

Keywords Water quality uncertainty; Incomplete mixing; Robust optimization; Info-gap decision theory; Treatment plant design; Water distribution system (WDS).

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