

Identification of Critical Elements in Water Distribution Networks using Resilience Index Measurement

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Abstract

Water Distribution Network (WDN) is a critical infrastructure to be maintained ensuring proper water supply to wide-spread consumers. The WDN consists of pipes, valves, pumps and tanks, and these elements interact each other to provide adequate system performance. If elements fail by internal or external interruptions, it may result in adverse impact to water service with different degree depending on the failed element. To determine an appropriate maintenance priority, the critical elements need to be identified and mapped in the network. In order to identify and prioritize the critical elements in WDN, an element-based simulation approach is proposed, in which all the elements composing the WDN are reviewed one at a time. The element-based criticality is measured using several resilience indexes that are newly developed in this study. The proposed resilience indexes are used to quantify the impacts of element failure to water service degradation. Here, three resilience indexes are developed, such as User Demand Severity, Economic Value Loss and Water Age Degradation, each of which intends to measure different aspects of consequences, such as social, economic, and water quality, respectively. For demonstration, the proposed approach is applied to a benchmark water network to identify and prioritize the critical elements.

Keywords : Critical element, Resilience index, Water distribution system

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