

World Environmental and Water Resources Congress 2018

Selected Papers from the
Proceedings of the World
Environmental and Water
Resources Congress 2018

Minneapolis, Minnesota
June 3-7, 2018

Hydraulics and Waterways, Water
Distribution Systems Analysis, and
Smart Water

ASCE

Edited by
Sri Kamojiala, P.E., D.WRE

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ENVIRONMENTAL &
WATER RESOURCES
INSTITUTE

WORLD ENVIRONMENTAL AND WATER RESOURCES CONGRESS 2018

*HYDRAULICS AND WATERWAYS, WATER DISTRIBUTION SYSTEMS
ANALYSIS, AND SMART WATER*

SELECTED PAPERS FROM THE WORLD ENVIRONMENTAL AND
WATER RESOURCES CONGRESS 2018

June 3–7, 2018
Minneapolis, Minnesota

SPONSORED BY
Environmental and Water Resources Institute (EWRI)
of the American Society of Civil Engineers

EDITED BY
Sri Kamojjala, P.E., D.WRE



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Preface

We are excited to offer the proceedings of the 2018 World Environmental and Water Resources Congress. The proceedings include published papers from an engaging and challenging array of technical sessions, posters, and workshops at the Environmental and Water Resources Institute's (EWRI) 18th annual Congress, held in Minneapolis, Minnesota, June 3-7, 2018. This conference is a leading venue for professional interaction among engineers and scientists, covering disciplines related to water and environmental resources and infrastructure.

Within the five (5) volumes of the proceedings, nearly 200 written scientific and technical papers from nearly 800 oral and poster presentations focusing on the subject areas of various EWRI Councils are included. A list of subject area tracks is included in the acknowledgements below. We hope these proceedings serve to enhance your knowledge and encourage you to follow up with more detailed publications by the same authors, and related papers, typically found in ASCE technical journals.

The collection of papers in this book, *World Environmental and Water Resources Congress, 2018: Hydraulics and Waterways, Water Distribution Systems Analysis, and Smart Water* contains papers organized by the following EWRI Councils:

- **Hydraulics and Waterways Council** whose purpose is to represent EWRI in technical matters pertaining to all aspects of hydraulic engineering of natural and man-made environmental systems. The Council promotes responsible water resources management and protection to foster sustainability and enhancement of the environment through the development, collection and dissemination of information and technology regarding the advancements and application of hydraulic engineering.
- **Symposium: WDSA (Committee)**: Water distribution systems analysis (WDSA) involves the quantitative planning, design, operations, management, modeling, and monitoring of hydraulics and water quality of water distribution systems. The purpose of the committee is to provide coordination for all activities within EWRI related to the field of water distribution systems analysis.
- **Symposium: Smart Water (Interdisciplinary Council)**: The Smart Water Symposium explored the development of emerging and innovative technologies through three technical sessions: Smart Sensing, Smart Water Grid and Intelligent Analytics. The papers cover interesting applications of "smart" technologies to drinking water, wastewater, stormwater and source water

Acknowledgments

Preparation and planning for this Congress strongly depends on the dedication of those individuals who plan session topics, solicit abstracts and papers, oversee reviews of all submissions and then “encourage” all authors to provide their material in a timely manner! We are deeply grateful to all who have provided this considerable effort, especially the track chairs listed below:

Track	Chairs
16th Groundwater Symposium	Paul Mathisen
Desalination Symposium	Bridget Wadzuk
Education	Cecilia Elmore
Emerging & Innovative Technologies	David Hill and Barak Fishbain
Environmental	Wendy Cohen and Lisa Hayes
History & Heritage	Larry Magura
Hydraulics & Waterways	Fabian A. Bombardelli
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International Issues	Ali Mirchi and Erfan Goharian
Irrigation & Drainage	Tom Ley
Planning and Management	Mashor Housh and Kaveh Madani
Professional Practice	Greg Scott
New Professionals	Colleen Bronner
Smart Water Symposium	Sudhir Kshirsagar and Branko Kerkez
Standards	Kathlie S. Jeng-Bulloch
Stormwater Symposium	Bill Hunt, Ruth Hocker and Bridget Wadzuk
Student Competition	Wes Lauer
Sustainability	David Cowan
Watershed	Don Frevert and Levent Kavvas
Water Distribution System Analysis (WDSA) Symposium	Regan Murray
Water, Wastewater and Stormwater	Bridget Wadzuk

We also acknowledge the members of the following Congress Organizing Committees, without whose time and efforts the event would not be possible.

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Finally, we acknowledge and thank the staff of the EWRI and ASCE who, in the end, makes this conference a reality. In particular, we thank Gabrielle Dunkley, EWRI's Manager, whose patience, perseverance, good humor, and great organizational talent ensure yet another successful EWRI Congress!

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