

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

Watershed Management, Irrigation
and Drainage, and Water Resources
Planning and Management

ASCE

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

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ENVIRONMENTAL &
WATER RESOURCES
INSTITUTE

WORLD ENVIRONMENTAL AND WATER RESOURCES CONGRESS 2018

*WATERSHED MANAGEMENT, IRRIGATION AND DRAINAGE, AND
WATER RESOURCES PLANNING AND MANAGEMENT*

SELECTED PAPERS FROM THE WORLD ENVIRONMENTAL AND
WATER RESOURCES CONGRESS 2018

June 3–7, 2018
Minneapolis, Minnesota

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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, Watershed Management, Irrigation and Drainage, and Water Resources Planning and Management* contains papers organized by the following EWRI Councils:

- **Watershed Council** whose purpose is to advance scientific and engineering principles for the collection, coordination, and dissemination of knowledge of watersheds from the standpoint of hydrologic, hydraulic, water quality and environmental processes.
- **Irrigation and Drainage Council** whose purpose is to promote responsible use of water resources and protection/enhancement of the environment through the development, collection and dissemination of information regarding the use and application of irrigation and drainage systems.
- **Planning and Management Council** whose purpose is to create, organize, and manage the activities of various technical committees dealing with water resources planning and management.

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 |
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| Hydro-climate/Climate Change Symposium | Levent Kavvas |
| International Issues | Ali Mirchi and Erfan Goharian |
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| 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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