

# **World Environmental and Water Resources Congress 2009**

**Kansas City, Missouri, USA  
17-21 May 2009**

**Volume 1 of 9**

**ISBN: 978-1-61567-190-8**

**Printed from e-media with permission by:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571



**Some format issues inherent in the e-media version may also appear in this print version.**

Copyright© (2009) by the American Society of Civil Engineers  
All rights reserved.

Printed by Curran Associates, Inc. (2009)

For permission requests, please contact the American Society of Civil Engineers  
at the address below.

American Society of Civil Engineers  
1801 Alexander Bell Drive  
Reston, VA 20191

Phone: (800) 548-2723  
Fax: (703) 295-6333

[www.asce.org](http://www.asce.org)

**Additional copies of this publication are available from:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571 USA  
Phone: 845-758-0400  
Fax: 845-758-2634  
Email: [curran@proceedings.com](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)

# TABLE OF CONTENTS

## VOLUME 1

### 11TH WATER DISTRIBUTION SYSTEMS ANALYSIS SYMPOSIUM (WDSA 09)

#### ASSET MANAGEMENT

<b>Bursts Identification in Water Distribution Systems</b> .....	1
<i>I. Borovik, B. Ulanicki, P. Skworcow</i>	
<b>Damage Detection of Operating Transmission Mains with Measured Boundary Conditions</b> .....	9
<i>Aaron C. Zecchin, Martin F. Lambert, Angus R. Simpson</i>	
<b>Evaluating Risk of Multi-Segment Pipes for Prioritizing Pipe Rehabilitation</b> .....	20
<i>M. Poulton, I. Kropp, A. Vanrenterghem-Raven</i>	
<b>Water Distribution Systems Corrective Maintenance Supported by Real-Time Use of Hydraulic Models</b> .....	31
<i>Juan G. Saldarriaga, Susana Ochoa, César A. Niño, Oscar J. Cortés</i>	
<b>Water Price Forecasting Method Based on Marginal-Cost Theory: A Case Study in China</b> .....	42
<i>Cui-Mei Li, Sui-qing Liu</i>	

#### FIELD WORK

<b>Assessing the Impact of Climate Change on Drinking Water Treatment Plant Design and Operation</b> .....	52
<i>Zhiwei Li, Robert M. Clark, Steven G. Buchberger, Y. Jeffrey Yang</i>	
<b>Axial Dispersion Coefficients for Laminar Flows in Water Distribution Systems</b> .....	61
<i>P. Romero-Gomez, Z. Li, C. Y. Choi, S. G. Buchberger</i>	
<b>Case Study: Homeowner's Preference Trade-Offs toward Plumbing Systems in Pipe Failure Prone Area</b> .....	71
<i>Juneseok Lee, Darrell Bosch, Ewa Kleczyk, Eftila Tanellari, Andrea M. Dietrich, Vinod K. Lohani</i>	
<b>Field-Scale Assessment of a Multispecies Water Quality System: A Chloramination Study</b> .....	79
<i>Matthew T. Alexander, Dominic L. Boccelli, Margaret J. Kupferle</i>	
<b>Pressure vs. Flow Relationship for Pipe Leaks</b> .....	93
<i>Thomas Walski, Brian Whitman, Mary Baron, Fred Gerloff</i>	
<b>Seoul (Korea) Online Water Quality Monitoring of Drinking Water</b> .....	103
<i>P. S. Shin, Y. R. Song, Y. J. Choi, Y. S. Park</i>	

#### HYDROLIC TRANSIENTS AND BIOFILMS

<b>Air/Vacuum Valve Breakage Caused by Pressure Surges – Analysis and Solution</b> .....	112
<i>Guohua Li, Christopher C. Baggett, Roberto A. Rosario</i>	
<b>The Impact of Biofilm Development on Pipe Roughness and Velocity Profile</b> .....	122
<i>Martin Francis Lambert, Ryan Wilson John Edwards, Sean James Howie, Benjamin Bernard De Gilio, Shane Pearse Quinn</i>	
<b>In-Line Partially Closed Valves: How to Detect by Transient Tests</b> .....	135
<i>S. Meniconi, B. Brunone, M. Ferrante</i>	
<b>Simple Model of Attachment and Detachment of Pathogens in Water Distribution System Biofilms</b> .....	145
<i>I. Schrottenbaum, J. Uber, N. Ashbolt, R. Murray, R. Janke, J. Szabo, D. Boccelli</i>	

#### NETWORK MODELING 1

<b>Impact of Storage Tanks on Energy Consumption in Municipal Water Distribution Systems</b> .....	158
<i>Santosh R. Ghimire, Brian D. Barkdoll</i>	
<b>Hydraulic Analysis of Water Distribution Network Using Harmony Search</b> .....	165
<i>Zong Woo Geem</i>	
<b>Integrated Hydraulic Analysis and Data Management Tool for Water Supply Systems in Developing Countries</b> .....	174
<i>Philipp Klingel, Nicolai Guth</i>	
<b>The Impacts of Demand Variability on Distribution System Hydraulics and Transport</b> .....	187
<i>Xueyao Yang, Dominic L. Boccelli</i>	

#### NETWORK MODELING 2

<b>Augmented Gradient Method for Head Dependent Modelling of Water Distribution Networks</b> .....	199
<i>Calvin Siew, Tiku T. Tanyimboh</i>	
<b>Enhanced Global Gradient Algorithm: A General Formulation</b> .....	209
<i>L. Berardi, O. Giustolisi, E. Todini</i>	
<b>Enhanced WDN Analysis: Representation of Actual Pipe Connections</b> .....	219
<i>O. Giustolisi</i>	

<b>Identification of the Hydraulic Model from Operational Measurements for Supervisory Pressure Control .....</b>	<b>228</b>
<i>Ping Li, Ian Postlethwaite, Emmanuel Prempain, Bogumil Ulanicki, Ridwan Patel</i>	

### **NETWORK MODELING 3**

<b>An Operative Approach to Water Distribution System Rehabilitation .....</b>	<b>238</b>
<i>L. Berardi, O. Giustolisi, D. Savic</i>	
<b>Calibration of Water Distribution Network Models as a Tool for Detecting Missing and Erroneous Cadastral and Hydraulic Information .....</b>	<b>251</b>
<i>Juan G. Saldarriaga, Susana Ochoa, Daniel Rodríguez, César M. Jurado</i>	
<b>Integrated Planning for Dual Distribution Systems .....</b>	<b>264</b>
<i>Nabin Khanal, Vanessa Speight, Venkatraman Radhakrishnan, Tim Francis, Laurel Passantino, James Swanson</i>	
<b>Reliability Analysis of Water Distribution Systems Using Graph Decomposition .....</b>	<b>272</b>
<i>Jochen Deuerlein, Andreas Wolters, Dietmar Roetsch, Angus R. Simpson</i>	

### **NETWORK MODELING 4**

<b>A Framework for Alternative Formulations of the Pipe Network Equations .....</b>	<b>283</b>
<i>Angus R. Simpson, Sylvan Elhay</i>	
<b>Inexpensive Modeling of Intermittent Service Water Distribution Networks.....</b>	<b>295</b>
<i>J. A. Cabrera-Bejar, V. G. Tzatchkov</i>	
<b>Operational Perspective of the Impact of Failures in Water Distribution Systems.....</b>	<b>305</b>
<i>J. Bicik, Z. Kapelan, D. A. Savi</i>	

### **NETWORK MONITORING AND SAMPLING**

<b>New Concepts for Meter Placement in Water Distribution Systems for Demand Estimation .....</b>	<b>315</b>
<i>Doo Sun Kang, Kevin Lansey</i>	
<b>Online Hydraulic State Prediction for Water Distribution Systems .....</b>	<b>323</b>
<i>Ami Preis, Andrew Whittle, Avi Ostfeld</i>	
<b>Sampling of Residential Water Use for Leak Control via Water Budgets.....</b>	<b>346</b>
<i>C. Arena, A. Criminisi, A. Fortunato, M. R. Mazzola</i>	
<b>Smart Pipe—Nanosensors for Monitoring Water Quantity and Quality in Public Water Systems .....</b>	<b>356</b>
<i>Yu-Feng Lin, Chang Liu, Jordan Whisler</i>	

### **NETWORK OPTIMIZATION 1**

<b>An Approach for Integrated Optimization of Wastewater, Recycled, and Potable Water Networks .....</b>	<b>364</b>
<i>Graeme Dandy, Alana Duncker, Joel Wilson, Xavier Pedoux</i>	
<b>Application of Optimization Technology to Water Distribution System Master Planning .....</b>	<b>375</b>
<i>C. K. Rogers, M. Randall-Smith, E. Keedwell, R. Diduch</i>	
<b>Industrial Distribution System Simulation for Optimal Water Resource Assignment Using Probabilistic Tabu Search.....</b>	<b>385</b>
<i>S. H. H. Nourzad, M. H. Afshar</i>	
<b>Optimal Pump Scheduling by Linear Programming .....</b>	<b>395</b>
<i>M. F. K. Pasha, K. Lansey</i>	

### **NETWORK OPTIMIZATION 2**

<b>An Integrated Approach for Distribution System Hydraulic Criticality and Emergency Response.....</b>	<b>405</b>
<i>Laura Jacobsen, Sri Kamojjala, Brian Bowler</i>	
<b>Decision Making under Information Constraints.....</b>	<b>414</b>
<i>Jianhua Xu, Jeanne M. VanBriesen, Mitchell J. Small, Paul S. Fischbeck</i>	
<b>Optimal Distribution of Pressure Measurement Points in Water Distribution Networks .....</b>	<b>423</b>
<i>Hui Zhang, Tinglin Huang</i>	
<b>Scalable Parallel Computing Framework for Pump Scheduling Optimization .....</b>	<b>430</b>
<i>Zheng Yi Wu, Qi Zhu</i>	

### **NETWORK SECURITY 1**

<b>A Multi-Objective Evolutionary Computation Approach to Hazards Mitigation Design for Water Distribution Systems.....</b>	<b>441</b>
<i>Lufthansa Kanta, Kelly Brumbelow, Emily Zechman</i>	
<b>Multi-Objective Sensor Placements with Improved Water Quality Models in a Network with Multiple Junctions .....</b>	<b>451</b>
<i>R. G. Austin, C. Y. Choi, A. Preis, A. Ostfeld, K. Lansey</i>	
<b>Robust Sensor Placement for Detecting Adversarial Contaminations in Water Distribution Systems .....</b>	<b>460</b>
<i>Andreas Krause, Carlos Guestrin</i>	

<b>Sensor Network Design and Performance in Water Systems Dominated by Multi-Story Buildings.....</b>	<b>470</b>
<i>Robert Janke, Terra Baranowski Haxton, Walter Grayman, Rakesh Bahadur, Regan Murray, William Samuels, Tom Taxon</i>	

## **NETWORK SECURITY 2**

<b>Comparative Evaluation of Two Algorithms for Locating Contaminant Ingress Points.....</b>	<b>484</b>
<i>Hailiang Shen, Edward McBean, Mirnader Ghazali</i>	
<b>Comparison of Pressures Simulated Using Transient Analysis with Field Data from a Full-Scale Distribution System.....</b>	<b>495</b>
<i>G. Ebacher, M.-C. Besner, J. Lavoie, B. S. Jung, B. W. Karney, M. Prévost</i>	
<b>Effects of Redesign of Water Systems for Security and Water Quality Factors.....</b>	<b>504</b>
<i>Walter M. Grayman, Regan Murray, Dragan A. Savic</i>	
<b>Propagation of Chlorine Demand Signals Induced by Microbial Contaminants in a Drinking Water Distribution System.....</b>	<b>515</b>
<i>D. E. Helbling, J. M. VanBriesen</i>	

## **NETWORK SECURITY 3**

<b>A Markov Chain Monte Carlo Implementation of Bayesian Contaminant Source Characterization in Water Distribution Systems under Stochastic Demands .....</b>	<b>525</b>
<i>Kenneth W. Harrison and Hui Wang</i>	
<b>Conditioned Backward Probability Modeling to Identify Contamination Sources in a Water Distribution System .....</b>	<b>536</b>
<i>R. M. Neupauer, M. K. Records</i>	
<b>Real-Time Implementation of Contamination Source Identification Method for Water Distribution Systems .....</b>	<b>544</b>
<i>Annamaria E. De Sanctis, Sam Hatchett, James G. Uber, Dominic L. Boccelli, Feng Shang</i>	
<b>Threat Perceptions and Risk Management in Urban Water Supply Schemes.....</b>	<b>554</b>
<i>Mitthan Lal Kansal, Aditya Tyagi</i>	

## **NETWORK SECURITY 4**

<b>Getting More from Your Investment Using Water Security Monitoring Technology for Everyday Operations .....</b>	<b>565</b>
<i>Dan Kroll</i>	
<b>Modeling a Hydraulic Response to a Contamination Event.....</b>	<b>575</b>
<i>Terranna Baranowski Haxton, Thomas M. Walski</i>	
<b>Novel, Rapid Molecular-Based Technique for Detecting Contamination in Drinking Water Distribution Systems.....</b>	<b>584</b>
<i>Stacia L. Thompson, Jeanne M. VanBriesen</i>	
<b>Trajectory Clustering Approach for Reducing Water Quality Event False Alarms.....</b>	<b>590</b>
<i>Eric Vugrin, Sean A. McKenna, David Hart</i>	

## **NETWORK WATER QUALITY ANALYSIS 1**

<b>Comparing Single- and Multi-Species Water Quality Modeling Approaches for Assessing Contamination Exposure in Drinking Water Distribution Systems .....</b>	<b>600</b>
<i>Stephen Klosterman, Sam Hatchett, Regan Murray, James Uber, Dominic Boccelli</i>	
<b>Real-Time Valve Operation for Water Quality Improvement in Water Distribution Systems .....</b>	<b>614</b>
<i>Doo Sun Kang, Kevin Lansey</i>	
<b>Simulation of Particle Transport in Drinking Water Distribution Systems .....</b>	<b>621</b>
<i>Klaus Ripl, Wolfgang Uhl</i>	
<b>WDS Water Quality Parameter Estimation and Uncertainty.....</b>	<b>635</b>
<i>M. F. K. Pasha, K. Lansey</i>	

## **NETWORK WATER QUALITY ANALYSIS 2**

<b>A Hybrid Heuristic Search Approach for Contaminant Source Characterization .....</b>	<b>645</b>
<i>Li Liu, E. Downey Brill, G. Mahinthakumar, S. Ranji Ranjithan</i>	
<b>Analysis of Model Sensitivity and Uncertainty for Chlorine Transport and Decay in a Water Distribution System .....</b>	<b>655</b>
<i>W. J. Dawsey, B. S. Minsker, A. Ostfeld</i>	
<b>Characterizing Reactive Contaminant Sources in a Water Distribution System .....</b>	<b>666</b>
<i>Jitendra Kumar, E. Downey Brill, G. Mahinthakumar, Ranji Ranjithan</i>	
<b>Low Pressure Propagation at Service Lines .....</b>	<b>672</b>
<i>Juneseok Lee, Vinod K. Lohani, Andrea M. Dietrich, G. V. Loganathan</i>	

## **NORTH AMERICAN DRINKING WATER INFRASTRUCTURE ASSESSMENT**

<b>Drinking Water Infrastructure Assessment: The National Research Council of Canada Perspective .....</b>	<b>681</b>
<i>Yehuda Kleiner, Balvant Rajani, Rehan Sadiq</i>	
<b>National Mains Failure Database Project.....</b>	<b>694</b>
<i>Neil S. Grigg</i>	

<b>Needs and Trends of the Nation’s Water Infrastructure—The Utility Perspective .....</b>	<b>700</b>
<i>Steven Buchberger, Robert Clark, Walter Grayman, Zhiwei Li, Matthew McCutcheon, Jeff Yang</i>	

**WATER USAGE**

<b>Combined Energy and Pressure Management in Water Distribution Systems .....</b>	<b>709</b>
<i>P. Skworcow, H. AbdelMeguid, B. Ulanicki, P. Bounds, R. Patel</i>	
<b>Design of Dual Water Supply Systems .....</b>	<b>719</b>
<i>R. Chee, D. S. Kang, K. Lansey, C. Y. Choi</i>	

**VOLUME 2**

<b>Modeling Domestic Water Demand on a Suburb Level.....</b>	<b>727</b>
<i>M. L. Griffioen, J. E. van Zyl, A. S. le Roux</i>	
<b>Preliminary Spatial-Temporal Statistical Analysis of Hourly Water Demand at Household Level.....</b>	<b>734</b>
<i>Ernesto Arandia-Perez, James G. Uber, Feng Shang, Dominic L. Boccelli, Robert Janke, David Hartman, Yeongho Lee</i>	

**6TH URBAN WATERSHED MANAGEMENT SYMPOSIUM**

<b>10,000 Rain Gardens, One Green Region .....</b>	<b>749</b>
<i>Tom Jacobs</i>	
<b>A Level Spreader—Vegetated Buffer System for Urban Stormwater Management .....</b>	<b>755</b>
<i>Ryan J. Winston, William F. Hunt</i>	
<b>A New Methodology to Evaluate Pollutant Removal of Gross Solids Separation Devices.....</b>	<b>765</b>
<i>D. P. Smith</i>	
<b>A Simplified Model of Combined Sewer Overflows to Estimate Event Driven Enteric Pathogen Concentrations in Drinking Water Sources .....</b>	<b>772</b>
<i>Rishab Mahajan, James Uber, Joseph Eisenberg</i>	
<b>Source Control: The Solution to Stormwater Pollution.....</b>	<b>782</b>
<i>Michael A. Ports</i>	
<b>A Student-Led Effort to Assess the Effect of Urban Runoff on Potter Lake.....</b>	<b>791</b>
<i>England Porter, John Kenny, Edward Peltier, C. Bryan Young</i>	
<b>A Tool for the Performance Assessment of Hydrodynamic Separators.....</b>	<b>799</b>
<i>Omid Mohseni, Janna M. Kieffer, Jennifer A. Koehler</i>	
<b>Accurate Sampling of Suspended Solids .....</b>	<b>807</b>
<i>Gregory P. DeGroot, John S. Gulliver, Omid Mohseni</i>	
<b>An Evaluation of Stormwater Wetlands in Series .....</b>	<b>814</b>
<i>J. M. Hathaway, W. F. Hunt</i>	
<b>An Innovative Approach for Modeling Large Urban Hydrologic Systems .....</b>	<b>824</b>
<i>J. P. Cantone, A. R. Schmidt</i>	
<b>Analysis of Bioretention Media Specifications and Relationships to Overall Performance .....</b>	<b>840</b>
<i>Sean W. O’Neill, Allen P. Davis</i>	
<b>Analyzing the Impacts of a Retrofit Detention Basin Flow Control Strategy on Biodiversity in an Urban Stream System.....</b>	<b>849</b>
<i>Natalie A. Postel, Christine A. Pomeroy, Tom A. Jacobs, Elangovan Karuppasamy</i>	
<b>Are Rational C Values Too Low? .....</b>	<b>856</b>
<i>C. B. Young, B. M. McEnroe, A. C. Rome</i>	
<b>Assessing Hydrodynamic Separators under High Water Flow Conditions.....</b>	<b>864</b>
<i>David Saddoris, Omid Mohseni, John Gulliver</i>	
<b>Assessment of Standard Sumps for Stormwater Treatment .....</b>	<b>875</b>
<i>Adam Howard, Omid Mohseni, John Gulliver, Heinz Stefan</i>	
<b>Bayesian Load Duration Curves for Bacterial Total Maximum Daily Loads: Urban Case Study .....</b>	<b>885</b>
<i>Mary Schoen, Mitchell Small, Jeanne VanBriesen</i>	
<b>Bioretention/Bioinfiltration Performance in the Mid-Atlantic .....</b>	<b>904</b>
<i>R. A. Brown, W. F. Hunt, A. P. Davis, R. G. Traver, J. M. Olszewski</i>	
<b>Breaking Down the Barriers to Low Impact Development in Colorado.....</b>	<b>914</b>
<i>Andrew Earles, Derek Rapp, Jane Clary, Janice Lopitz</i>	
<b>Challenges in Attaining Recreational Stream Standards for Bacteria: Setting Realistic Expectations for Management Policies and BMPs.....</b>	<b>924</b>
<i>Jane Clary, Jonathan Jones, Ben Urbonas</i>	
<b>Characterizing Water Inputs to Catchments in the Santa Monica Mountains with <math>\delta^{18}O</math> and <math>\delta D</math> .....</b>	<b>934</b>
<i>W. Hu, B. Hibbs, R. Bugarin</i>	
<b>Clark County Regional Flood Control District Arc Hydro (CCRFCD Arc Hydro): Toward Ongoing Stormwater Master Planning.....</b>	<b>942</b>
<i>Stephen Bourne, Kevin Eubanks, Harshal Desai, Brian Rowley</i>	
<b>Codorus Creek Restoration—A Case Study for the Chesapeake Bay .....</b>	<b>950</b>
<i>Matthew P. Hoch, Christina Y. S. Siu, Shirley E. Clark, Katherine H. Baker</i>	
<b>Combining GIS, BMP Performance, and Strategic Planning to Support Water Quality Implementation Planning .....</b>	<b>957</b>
<i>Ken Susilo, Marc Leisenring, Eric Strecker</i>	

<b>Considerations, Opportunities, and Strategies for Infiltration Stormwater BMPs</b> .....	971
<i>Ken Susilo, Neven Matasovic, Ronald S. Johnson</i>	
<b>Construction and Performance of Bioretention Cells</b> .....	981
<i>G. O. Brown, R. A. Chavez, D. E. Storm, M. D. Smolen</i>	
<b>Cost Estimating Tools for Low-Impact Development Best Management Practices</b> .....	991
<i>C. Dasch Houdeshel, Christine A. Pomeroy, Lisa Hair, Robert Goo</i>	
<b>Data Reporting Guidelines for Certification of Manufactured Stormwater BMPs: Part II</b> .....	1004
<i>Robert M. Roseen, Ernie Carrasco, Yuan Cheng, Bill Hunt, Charlene Johnston, Jim Mailloux, Walt Stein, Tim Williams</i>	
<b>Design of Integrated Bioinfiltration-Detention Urban Retrofits with Continuous Simulation Methods</b> .....	1010
<i>William C. Lucas</i>	
<b>Design Optimization of Hydrodynamic Separators</b> .....	1020
<i>James H. Lenhart, Joanna B. Ogintz, Scott A. de Ridder</i>	
<b>Developing a Water Budget for a Constructed Stormwater Wetland</b> .....	1027
<i>Kristen Mogavero, Gerrad Jones, Bridget Wadzuk</i>	
<b>Effects of Media Depth on Bioretention Performance in the Upper Coastal Plain of North Carolina and Bioretention Construction Impacts Study</b> .....	1037
<i>R. A. Brown, W. F. Hunt</i>	
<b>Engineered Waste Materials as Amendments to Prevent Erosion and to Stabilize Contaminated Sites</b> .....	1047
<i>S. P. Kakuturu, M. Xiao, L. N. Reddi</i>	
<b>Enhancing Rain Garden Design to Promote Nitrate Removal</b> .....	1055
<i>Emilie K. Stander, Michael Borst, Thomas P. O'Connor, Amy A. Rowe</i>	
<b>EPA Aging Water Infrastructure Research Program: State of the Technology for the Condition Assessment and Rehabilitation of Wastewater Collection Systems</b> .....	1066
<i>Daniel J. Murray Jr.</i>	
<b>Evaluation and Optimization of Distributed Stormwater Controls in Spreadsheet</b> .....	1073
<i>Joong Gwang Lee, Scott Struck</i>	
<b>Evaluation of Atriplex Shrubs Growth in Semi Arid Area</b> .....	1083
<i>Mehemed A. Razzaghi</i>	
<b>Evolutionary Optimization of Combined Sewer Overflow Control</b> .....	1092
<i>Andrea Zimmer, David Hill, Barbara Minsker, Avi Ostfeld, Arthur Schmidt</i>	
<b>Examination of Pervious Concrete and Porous Asphalt Pavements Performance for Stormwater Management in Northern Climates</b> .....	1105
<i>Kristopher M. Houle, Robert M. Roseen, Thomas P. Ballestero, Joshua F. Briggs, James J. Houle</i>	
<b>Field Evaluation of Indicator Bacteria Removal by Stormwater BMPs in North Carolina</b> .....	1123
<i>J. M. Hathaway, W. F. Hunt, J. D. Wright, S. J. Jadlocki</i>	
<b>Field Testing Guidelines for Certification of Manufactured Stormwater BMPs: Part II</b> .....	1133
<i>John Sansalone, Jeff Benty, Ernie Carrasco, John Gulliver, Jon Hathaway, Bill Hunt, Masoud Kayhanian, Uday Khambhammettu, Robert M. Roseen, Betty Rushton, Tim Williams</i>	
<b>From Grey to Green: Strategies and Concepts for Implementing Green CSO and Wet Weather Solutions</b> .....	1143
<i>James C. Schlaman, Bryce Lawrence, Scott Schulte</i>	
<b>Generalized Storage-Reliability-Yield Equations for Rainwater Harvesting Systems</b> .....	1172
<i>Lars S. Hanson, Richard M. Vogel, Paul Kirshen, Peter Shanahan</i>	
<b>How the Heart of America is Goin' Green to Solve Water and Sewer Issues</b> .....	1182
<i>Lynn Hinkle, Michael Ports</i>	
<b>Graywater Irrigation as a Means to Meet Water Demands in Arid Regions</b> .....	1189
<i>Sybil Sharvelle, Masoud N. Azar, Mary Stromberger, Larry Roesner</i>	
<b>HCFC M3 System: Maximizing and Maintaining Local Investments in Floodplain Modeling</b> .....	1199
<i>Karl McArthur, Stephen Bourne, Yu-Chun Su, Jacob Spenn</i>	
<b>Hydrologic Footprint Residence: A New Metric to Assess Hydrological Alterations Due to Urbanization</b> .....	1209
<i>M. H. Giacomoni, E. M. Zechman</i>	
<b>Hypothesis-Based Flow Monitoring for Green Solutions</b> .....	1217
<i>Deb O'Bannon, Erich Schmitz</i>	
<b>Impact of Wet-Weather Peak Flow Blending on Disinfection Performance</b> .....	1221
<i>Mary K. Stinson, Richard Field, R. Boris Rukovets</i>	
<b>Improving Hydrologic Sustainability of Texas A&amp;M University Campus</b> .....	1238
<i>Prakash Khedun, Chandana Damodaram, Marcio Giacomoni, Andrea Ryan, Hillary Holmes, Ross Klein, William Saour, Michelle Hollingsworth, Troy Berthold, Meg Davis, Philip Bullock, Neetha Ravikumar, Emily Zechman, Georgianne Moore, Bryan Boulanger, Radu Stoleru</i>	
<b>An Investigation of Infiltration in a Constructed Stormwater Wetland and Implications for Groundwater Quality</b> .....	1248
<i>Gerrad Jones, Kristen Mogavero, Bridget M. Wadzuk</i>	
<b>Integration of Low Impact Development Studies into the International Stormwater BMP Database</b> .....	1259
<i>Jane Clary, Marcus Quigley, Andrew Earles, Marc Leisenring, Eric Strecker, Jonathan Jones</i>	
<b>Kansas City—Balancing Green Infrastructure with Traditional Approaches for CSO Control</b> .....	1269
<i>Scott D. Struck, Tom Jacobs, Ginny Moore, Robert Pitt, Michael A. Ports, Deborah O'Bannon, Erich Schmitz, Richard Field</i>	
<b>Kansas City, Missouri Overflow Control Plan Summary</b> .....	1278
<i>Terry Leeds, Scott Struck</i>	
<b>Kansas City's Stream Setback Ordinance: A Case Study on the Benefits of Stream Buffers in Urban Areas</b> .....	1291
<i>Laurie Brown, Scott Schulte, Bryce Lawrence</i>	
<b>KC-One: Comprehensive City-Wide Management Plan Creates Leading Stormwater Management Program</b> .....	1300
<i>J. W. Henson, R. Gaskin</i>	

<b>Laboratory Testing Guidelines for Certification of Manufactured Stormwater BMPs</b> .....	1309
<i>Roger Bannerman, Hans de Bruijn, Shohreh Karimpour, Masoud Kayhanian, Jim Mailloux, Jon McDonald, Mark Miller, Omid Mohseni, Kwabena Osei, Scott Perry</i>	
<b>Land Use and Runoff Uncertainty</b> .....	1314
<i>Celina Bochis, Robert E. Pitt</i>	
<b>Linking Environmental Assessment and Solutions</b> .....	1325
<i>L. Gosselink, C. Herrington, R. H. Glick</i>	
<b>Long-Term Effectiveness of a Bioretention System Treating Road Runoff in Northeastern Kansas</b> .....	1335
<i>Edward Peltier, Xiaolu Chen, Kelly Kindscher, C. Bryan Young</i>	
<b>Looking Upstream and into the Watershed for the Big Picture of Stream Health</b> .....	1344
<i>Christina Y. S. Siu, Shirley E. Clark, Ruth A. Sittler, Katherine H. Baker</i>	
<b>LID-SWM Practices as a Means of Resilience to Climate Change and Its Effects on Groundwater Recharge</b> .....	1354
<i>Iulia A. Barbu, Thomas P. Ballestero, Robert M. Roseen</i>	
<b>Maintenance of Stormwater BMPs</b> .....	1364
<i>Andrew J. Erickson, Joo-Hyon Kang, Peter T. Weiss, C. Bruce Wilson, John S. Gulliver</i>	
<b>Modeling Performances of Detention Basins with Uncertainty Analysis</b> .....	1372
<i>Daeryong Park, Larry A. Roesner</i>	
<b>Monitoring the Hydrologic Effects of an Extensive Green Roof</b> .....	1382
<i>Nathaniel Hanna Holloway, Charles J. Werth, Arthur R. Schmidt</i>	
<b>Multiple Watershed Scales Approach for Placement of Best Management Practices in SUSTAIN</b> .....	1400
<i>Fu-hsiung Lai, Jenny Zhen, John Riverson, Khalid Alvi, Leslie Shoemaker</i>	
<b>Nexus Projects in Kansas City's Suburban Watersheds</b> .....	1410
<i>Brian Rast</i>	
<b>Non-Point Source Nutrient Loading in an Urban Watershed</b> .....	1431
<i>Eric Gurr, Fidelia Nnadi</i>	
<b>Pervious Pavement System Evaluation</b> .....	1440
<i>Amy A. Rowe, Michael Borst, Thomas P. O'Connor, Emilie K. Stander</i>	
<b>Planning for Sustainable Growth and Water Resources in the Chesapeake Bay Watershed</b> .....	1448
<i>Thomas E. Dumm</i>	
<b>Pollutant Transport within the Vadose Zone: Interactions of Soil Horizon Chemistry on Water Quality</b> .....	1451
<i>Daniel P. Treese, Shirley E. Clark, J. Bradley Mikula, Katherine H. Baker</i>	

### VOLUME 3

<b>Potential Data Analysis Methodology to Evaluate the Performance of Manufactured BMPs</b> .....	1460
<i>Masoud Kayhanian, Robert M. Roseen, James H. Lenhart, Greg Williams</i>	
<b>Proposed Scaling Relations for Manufactured Stormwater BMPs</b> .....	1470
<i>John S. Gulliver, Qizhong Guo, John J. Sansalone, Gregory Williams, J. S. Wu</i>	
<b>Rainwater Harvesting for Non-Potable Use in Gardens: A Comparison of Runoff Water Quality from Green vs. Traditional Roofs</b> .....	1478
<i>Natasha Nicholson, Shirley E. Clark, Brett V. Long, Julia Spicher, Kelly A. Steele</i>	
<b>Redesigning Constructed Stormwater Wetlands: An Integrated Modeling Approach to Optimize Form and Function</b> .....	1488
<i>G. D. Jones, K. A. Mogavero, B. M. Wadzuk</i>	
<b>Research of Hydrologic and Water Quality Performance of Four Linear Wetlands in Eastern North Carolina</b> .....	1498
<i>J. D. Wright, W. F. Hunt</i>	
<b>Reservoir Sedimentation Estimation Using Genetic Programming Technique</b> .....	1505
<i>Vaibhav Garg, V. Jothiprakash</i>	
<b>Sediment Monitoring Bias by Autosampler in Comparison with Whole Volume Sampling for Parking Lot Runoff</b> .....	1514
<i>George D. Fowler, Robert M. Roseen, Thomas P. Ballestero, Qizhong Guo, James Houle</i>	
<b>Selecting Optimal Water Supply Options—A Regional Water Supply Case Study in the Upper Kissimmee Basin, FL</b> .....	1523
<i>Aditya Tyagi, Mitchell Griffin, Richard Nevulis, Chris Sweazy</i>	
<b>Simplified Solution for Groundwater Mounding under Round Stormwater Infiltration Facilities</b> .....	1535
<i>Kaveh Zomorodi</i>	
<b>South Lake Park Bioretention Gardens</b> .....	1552
<i>J. J. Dremsa, T. A. Hartsig</i>	
<b>State of the Practice of Wet Weather Flow Analysis</b> .....	1562
<i>Mitchell Heineman</i>	
<b>The Application of Environmental Site Design Processes to Design a Residential Subdivision</b> .....	1572
<i>Steven D. Trinkaus</i>	
<b>Effect of Bioretention on Runoff Temperature in Trout Sensitive Regions</b> .....	1582
<i>Matthew Jones, William F. Hunt</i>	
<b>The Lawrence Technological University Greenroof Performance Evaluation Project</b> .....	1589
<i>Donald D. Carpenter, Preethi Kaluvakolanu</i>	
<b>The Road to LID Plan Approval in Coastal North Carolina: Development of a Spreadsheet Modeling Tool for LID Based Designs</b> .....	1600
<i>Hunter Freeman</i>	



<b>The Runoff Reduction Method</b> .....	1610
<i>Kelly A. Collins, Dave Hirschman, Greg Hoffmann, Tom Schueler</i>	
<b>Unit Process Modeling of Stormwater Flow and Pollutant Sorption in a Bioretention Cell</b> .....	1622
<i>Zhuangxiang He, Allen P. Davis</i>	
<b>Use of the Basin Development Factor to Evaluate Urban Watershed Response</b> .....	1631
<i>Shiva Sunder, Theodore G. Cleveland, David B. Thompson</i>	
<b>Water Quality and Hydraulic Properties of the Permeable Friction Course</b> .....	1641
<i>Michael Barrett, Brandon Klenzendorf, Brad Eck, Randall Charbeneau</i>	
<b>Water Quality Design Storms for Stormwater Hydrodynamic Separators</b> .....	1651
<i>Victoria Julia Fernandez-Martinez, Qizhong Guo</i>	
<b>Water Sustainability Index: Application of CWSI for Ahwaz County</b> .....	1664
<i>J. Attari, S. A. Mojahedi</i>	
<b>Development of Watershed Management Modeling System: The Los Angeles County Flood Control District's Watershed Based Approach for Urban Runoff and Stormwater Quality</b> .....	1671
<i>Youn Sim</i>	

## **7TH SYMPOSIUM ON GROUNDWATER, HYDROLOGY, QUALITY, AND MANAGEMENT**

### **AQUIFER CHARACTERIZATION AND PROTECTION**

<b>Implementing Source Water Protection Programs in Texas</b> .....	1681
<i>Camille W. Sowells, Christina Petersen, Gordon McCurry, Alexandria Doody, Sean Ables</i>	
<b>Lithostratigraphy of Nigeria—An Overview</b> .....	1689
<i>Kazeem Akorede Shitta</i>	
<b>Specific Problems Related to Partially Penetrating Wells in Confined Aquifers</b> .....	1697
<i>Ahmad Wagdy, Hany G. Radwan, Sherif M. El-Didy</i>	
<b>Tool for Estimation of Additional Drawdown Due to Partially Penetrating Wells in Confined and Semi-Confined Aquifers</b> .....	1710
<i>Ahmad Wagdy, Hany G. Radwan, Sherif M. El-Didy</i>	

### **GROUNDWATER CHARACTERIZATION AND MONITORING**

<b>A Novel Approach to Groundwater Model Development</b> .....	1721
<i>Thomas D. Krom, Richard Lane</i>	
<b>Groundwater Mixing Using Pulsed Dipole Injection/Extraction Wells</b> .....	1730
<i>C. R. Radabaugh, D. C. Mays, R. M. Neupauer</i>	

### **GROUNDWATER MANAGEMENT AND ITS UNCERTAINTY**

<b>A Critical Realization Identification Method Based on Pareto Dominance Analysis</b> .....	1735
<i>J. Wang, J. Guan, M. M. Aral</i>	
<b>Combining Rule-Based Fuzzy Model with GIS to Predict Groundwater Vulnerability to Contamination</b> .....	1743
<i>Dhundi R. Pathak, Akira Hiratsuka, Isao Awata, Luonan Chen</i>	
<b>Evaluation of Alternative Geospatial Models Using Image Ranking and Machine Learning: An Application in Shallow Groundwater Recharge and Discharge</b> .....	1753
<i>Yu-Feng Lin, Peter Bajcsy, Alex Yahja, Chulyun Kim</i>	
<b>Implementation of the Sustainable Development Concept in the Field of Groundwater Management</b> .....	1757
<i>C. Schöpfer</i>	
<b>Projecting Future Groundwater Availability for Power Generation Plant Licensing</b> .....	1767
<i>G. A. Day and C. Krambis Jr.</i>	
<b>Simulation of Subsurface Water Flow by Galerkin Finite Element Method in Dhaka City Aquifer</b> .....	1777
<i>Shikha Rahman, Mohammad A. Bhuiyan</i>	

### **GROUNDWATER QUALITY AND HUMAN HEALTH**

<b>A Methodology to Reconstruct Groundwater Contamination History with Limited Field Data</b> .....	1787
<i>Jiabao Guan, Morris L. Maslia, Mustafa M. Aral</i>	
<b>A Tale of Two Cities—Source Water Protection Case Studies for Systems in Rural Settings</b> .....	1794
<i>Tina Petersen, Camille W. Sowells, Gordon McCurry, Alexandra Doody, Claudia Krug, Sean Ables</i>	
<b>Quantifying the Spread of Arsenic Contamination in Groundwater of the Brahmaputra Floodplains, Assam, India: A Threat to Public Health of the Region</b> .....	1804
<i>C. Mahanta, N. Pathak, R. Choudhury, P. Borah, W. Alam</i>	
<b>Vadose Zone Transport of Nitrate in the Sierra Pelona Groundwater Basin, Agua Dulce, California</b> .....	1814
<i>Claudia T. Krug, Zbigniew Kabala</i>	

## **GROUNDWATER QUALITY MODELING – SOLUTE TRANSPORT AND REACTIVE TRANSPORT**

<b>Exploring the Potential of Nonlinear and Non-Equilibrium Alcohol Partitioning for Assessment of DNAPL Source Zone Architecture</b> .....	1824
<i>Rhiannon E. Ervin, C. Andrew Ramsburg</i>	
<b>Solute Flux Rate Uncertainty Evaluation at a Monitored Boundary</b> .....	1833
<i>David E. Langseth</i>	
<b>An Analytical Solute Transport Model for In Situ Estimation of Retardation</b> .....	1842
<i>Gustavious Paul Williams, David Tomasko</i>	
<b>Assessing Postulated Accidental Releases of Radioactive Liquid Effluents from Nuclear Power Plants</b> .....	1850
<i>S. W. Taylor, G. A. Day, A. N. Findikakis, G. A. McLane, L. E. Young</i>	
<b>Modeling of Chlorinated VOCs Transport under Dual Bioreactions</b> .....	1860
<i>Wonyong Jang, Mustafa M. Aral</i>	
<b>Reaction Rates in a Transport System with Both Kinetic and Equilibrium Reactions</b> .....	1867
<i>Gour-Tsyh Yeh, Yilin Fang</i>	

## **IMPACTS OF URBANIZATION ON GROUNDWATER QUALITY AND QUANTITY**

<b>Comparative Study of Two Standard Septic Tank Drain Fields Using Different Sand with Recirculation for Nutrient Removal</b> .....	1893
<i>Ni-Bin Chang, Marty Wanielista, Fahim Hossian, Zhemini Xuan, Ammarin Daranpob</i>	
<b>Environmental Impacts on Surface Water and Groundwater for Expanding Urban Water Supply Capacity Using Stone Quarries</b> .....	1907
<i>Xing Fang, Ni-Bin Chang, Ming-Kuo Lee, Lorraine Wolf</i>	
<b>Groundwater Baseflow Sourced from Miocene Rocks and Residuals Carries Elevated Selenium into Southern California</b> .....	1919
<i>Barry Hibbs, Mercedes Merino, Rachel Andrus, Wynne Hu, Anna Doron</i>	
<b>Investigating the Temperature Effects on Nutrient Removal in Green Sorption Media</b> .....	1929
<i>Ni-Bin Chang, Marty Wanielista, Devan Henderson, Ammarin Daranpob</i>	
<b>Nutrient and Pathogen Removal with an Innovative Passive Underground Drainfield for On-Site Wastewater Treatment</b> .....	1939
<i>Ni-Bin Chang, Marty Wanielista, Ammarin Daranpob, Fahim Hossian, Zhemini Xuan</i>	
<b>Selection and Prioritization of Best Management Practices for Potential Sources of Contamination in a Wellhead Protection Area</b> .....	1951
<i>Tina Petersen, Camille W. Sowell, Gordon McCurry, Alexandria Doody, Sean Ables</i>	

## **INTERACTION OF STREAM AND GROUNDWATER AND INTEGRATED MANAGEMENT**

<b>Controlling Saltwater Intrusion to Environmental Sensitive Areas Due to the Construction of the Rio Anton Ruiz Flood Control Project</b> .....	1960
<i>David Weston, Rafael Velez</i>	
<b>Estimating Groundwater Seepages to St. Lucie Estuary</b> .....	1971
<i>Gour-Tsyh Yeh, Jae-Young Lee, Gordon Hu, Detong Sun</i>	
<b>Analytical-Numerical Solution for Seepage along an Earth Canal Disconnected from the Shallow Aquifer</b> .....	1990
<i>Yi Liu, Zhuping Sheng</i>	
<b>Hydrogeologic Investigation for New Water Supply for Water District No. 1 of Johnson County, Kansas</b> .....	1999
<i>J. W. Henson, T. Schrempp, M. B. Horsley, K. L. Hahn</i>	

## **PROBABILISTIC METHODS FOR AQUIFER PARAMETER ESTIMATION AND GROUNDWATER MODELING AND INVERSE MODELING**

<b>A Heuristic Algorithm for Optimal Alignment and Matching of Borehole Stratigraphy</b> .....	2006
<i>Gustavious P. Williams, Norman Jones, Jeffrey Handy</i>	
<b>Composite Analysis of Test-Well and Observation-Well Data during Constant-Head Test</b> .....	2014
<i>Yen-Ju Chen, Hund-Der Yeh</i>	
<b>Wavelet Analysis of Characteristic Length Scales of Permeability in Stationary and Non-Stationary Porous Media</b> .....	2022
<i>X. Qi, R. M. Neupauer</i>	

## **EDUCATION AND RESEARCH**

<b>Framing the Design Process in an Undergraduate Environmental Engineering Class</b> .....	2031
<i>Deb O'Bannon, Tom Kimes</i>	
<b>Integrating Design Heuristics in an Environmental Engineering Course</b> .....	2034
<i>Kathleen M. Leonard</i>	
<b>Non-Traditional University Research Partners That Facilitate Service Learning and Graduate Research for Sustainable Development</b> .....	2038
<i>M. A. Trotz, H. E. Muga, L. D. Phillips, D. Yeh, A. Stuart, J. R. Mihelcic</i>	

## **EMERGING AND INNOVATIVE TECHNOLOGY**

### **EIT POSTERS**

<b>A Decision Support System for Beneficial Use of National Dam Water Resources in Swaziland</b> .....	2049
<i>J. I. Matondo, K. M. Msibi</i>	
<b>Assessment of Combined Hydroseeding and Coconut Reinforcement to Control Soil Erosion</b> .....	2063
<i>Mervin M. Cereno</i>	
<b>Designing Effective Rainfall Harvesting Systems in Developing Areas of Sub-Saharan Africa</b> .....	2073
<i>Emmanuel U. Nzewi</i>	
<b>Innovative Design at Lake Lenexa</b> .....	2085
<i>Scott R. Brand, Tom A. Jacobs</i>	
<b>Production of Drinking Water from Lake Water Sources with a Nanofilter Membrane to Prevent the Formation of Disinfection Byproducts</b> .....	2096
<i>Rajib Sinha, Anita Anderson, Craig Patterson, David Pearson</i>	
<b>Rainwater Harvesting Experiences in the Humid Southeast USA</b> .....	2105
<i>Matthew Jones, William F. Hunt, Jason Wright</i>	

## **EMERGING AND INNOVATIVE TECHNOLOGY IN WASTEWATER TREATMENT**

<b>Deployable Decentralized Biofilm System to Degrade Organic Carbon, Nutrients and Benzene from Wastewater</b> .....	2112
<i>Dong Chen, Che-Jen Lin, R. Gavin Jones, Sehul Patel, Rachele Smith, Thomas G. Chasteen, Micheal Radi, Sabin Holland, Scott A. Waisner, Jeffery L. Davis</i>	
<b>Development of Slow-Release Chemical Oxidation Methods for Environmental Remediation</b> .....	2124
<i>Stephanie Luster-Teasley, Patrick Onochie</i>	
<b>Peracetic Acid as an Alternative Disinfection Technology for Wet Weather Sewer Overflows</b> .....	2135
<i>E. Coyle, L. Ormsbee</i>	
<b>Recycling of Multiple Waste Streams for Transportation Fuel Production via Algae Cultivation at Wastewater Treatment Plants</b> .....	2145
<i>Patrick J. Dunlap, Andrew R. Shaw</i>	

## **EMERGING AND INNOVATIVE TECHNOLOGY IN WATER TREATMENT**

<b>Development of a Community Water Security Filtration System Using Composite Cartridges</b> .....	2155
<i>Nur Muhammad, Rajib Sinha, E. Radha Krishnan, Craig L. Patterson, Roy C. Haught, Harold H. Harms, Rick Seville</i>	
<b>Evaluation of a UV/Ozone Treatment Process for Removal of MTBE in Groundwater Supplies in New Mexico</b> .....	2166
<i>Craig Patterson, Fernando Cadena, Rajib Sinha, Dzung Kim Ngo-Kidd, Abbas Ghassemi, E. Radha Krishnan</i>	
<b>Removal of Waterborne Particles by Electrofiltration</b> .....	2173
<i>J. Murphy, Y. Li, R. Ehrhard, K. Carns, C. Patterson, R. Krishnan, R. Sinha</i>	
<b>Water Distribution Optimization: Taking SCADA One Step Forward</b> .....	2182
<i>Chuck Weber, Simon Bunn</i>	

## **VOLUME 4**

### **ENVIRONMENTAL CYBER-SENSING AND MODELING I**

<b>ARC Population and Employment Allocation Disaggregator—A Simple GIS-Based Tool for Parcel-Scale Population Projection</b> .....	2191
<i>Stephen Bourne, Mike Alexander, Wei Wang</i>	
<b>How to Build a Broadly Useable GIS Toolset for Estuary Analysis</b> .....	2201
<i>Stephen Bourne, Sandra Fox, Palmer Kinsler</i>	
<b>Predicting CSOs for Real Time Decision Support</b> .....	2210
<i>D. J. Hill, B. Minsker, A. Schmidt</i>	
<b>Protocol Considerations to Improve the Reliability of Data Collection in a Radio Telemetry System</b> .....	2220
<i>Daniel Lasorso, Patrick Garrett, Craig L. Patterson</i>	
<b>Visualizing Hydrologic Drought Information on the Web Using State-of-the-Art Geospatial Mapping Technology</b> .....	2236
<i>Jae Ryu, Mark Svoboda, Jane Okalebo</i>	

### **ENVIRONMENTAL CYBER-SENSING AND MODELING II**

<b>“Let It Rain”—Gage-Adjusted Radar Rainfall (GARR) Data for Peachtree Creek Sewer Basin Modeling</b> .....	2242
<i>Alberto Bechara, Jim Moffitt, Vahe Kokorian, Rasheed Ahmad</i>	
<b>Adaptive Long-Term Monitoring at BP Environmental Restoration Sites</b> .....	2255
<i>Matthew Zavislak, John Dustman, Dennis Beckmann</i>	
<b>Application of Radio Frequency Tracers to Individual and Group Particle Displacement within a Laboratory</b> .....	2264
<i>T. J. Lauth, A. N. Papanicolaou</i>	

<b>Cost-Effective Automated Water Quality Monitoring Systems Providing High-Resolution Data in Near Real-Time .....</b>	<b>2272</b>
<i>Rob Ellison, Mike Cook</i>	
<b>South Florida Water Control System Tracker: Real-Time Water Budgeting for Pragmatic Water Control Operations .....</b>	<b>2282</b>
<i>Leslie Gowdich, Stephen Bourne, Lakin Flowers, Ken Stewart, Jack Hampson</i>	

### **INTERDISCIPLINARY EDUCATION PROGRAMS**

<b>Coordinating and Implementing a Graduate Course on Interdisciplinary Modeling for Water-Related Issues.....</b>	<b>2292</b>
<i>Laurel Saito</i>	
<b>Experiences Teaching a Multi-Disciplinary Course .....</b>	<b>2295</b>
<i>Daniel P. Loucks</i>	

### **RURAL WATER SUPPLY SYSTEMS IN DEVELOPING COUNTRIES**

<b>Water Resources in Sudan: Enhancing Rainfall Harvesting Methods for Water Supply .....</b>	<b>2300</b>
<i>S. Mohamed-Ali, S. Luster-Teasley, E. Nzewi</i>	

### **WATER RESOURCES AND ENVIRONMENTAL VISION 2050**

<b>Environment and Water Resources in 2050: The Challenge for Engineering Education.....</b>	<b>2311</b>
<i>Jeff R. Wright</i>	
<b>Environmental and Developmental Risks and Stressors Impacting a 2050 Vision.....</b>	<b>2316</b>
<i>Walter M. Grayman</i>	
<b>Flood Risk Management Circa 2050 .....</b>	<b>2326</b>
<i>Gerald Galloway</i>	
<b>Urban Stormwater Management in 2050 .....</b>	<b>2336</b>
<i>James P. Heaney, John J. Sansalone</i>	
<b>Urban Water and Wastewater Management in 2050 .....</b>	<b>2345</b>
<i>Glen T. Daigger</i>	

### **WATER RESOURCES DISASTERS WAITING TO HAPPEN**

<b>Challenges of Managing California’s Sacramento—San Joaquin Delta .....</b>	<b>2355</b>
<i>Jay R. Lund, Ellen Hanak, William E. Fleenor, William A. Bennett, Richard E. Howitt, Jeffrey F. Mount, Peter B. Moyle</i>	
<b>Characterization of Water Resources and Environmental Disasters .....</b>	<b>2365</b>
<i>Walter M. Grayman</i>	
<b>How Reliable is New York City’s Water Supply? .....</b>	<b>2372</b>
<i>Daniel P. Loucks</i>	

### **ENVIRONMENTAL**

#### **ENVIRONMENTAL MODELING**

<b>Assessing Pollutant Loads and Evaluation of Treatment Systems to Achieve Water Quality Goals for Land Development Projects.....</b>	<b>2376</b>
<i>Steven D. Trinkaus</i>	
<b>Characterization of a Perchlorate Contaminated Site .....</b>	<b>2386</b>
<i>Yacoub Najjar, Sam Mryyan</i>	
<b>Numerical Modeling of Ozonation of Organic Chemicals in Surface Water .....</b>	<b>2397</b>
<i>Tingting Zhu, Yafei Jia, Ajit Sadana, Sam S. Y. Wang</i>	
<b>Simulation of Tehran Air Pollution Using Artificial Neural Networks.....</b>	<b>2407</b>
<i>Ali Yazdanpanahrostami, Kabir Rasouli</i>	

#### **ENVIRONMENTAL PERMITTING**

<b>Distributed Power Generation at State Facilities: Economic Analysis of Savings and Carbon Credits .....</b>	<b>2418</b>
<i>Joel G. Burken, A. Curt Elmore, Mariesa Crow, Will Granich, Trenton Blair</i>	
<b>Drive for Zero Net Carbon Impact.....</b>	<b>2427</b>
<i>Jessica Lamb, Ashlynn Horras, Luke Fencl, Courtney Warren, Sebastian Medina</i>	
<b>Permitting of Confined Animal Feeding Operations: Issues and Challenges.....</b>	<b>2434</b>
<i>William F. Ritter, S. Rao Chitikela</i>	

## **ENVIRONMENTAL SUSTAINABILITY**

<b>A Comparative Study of Water Quality Indices for Karun River</b> .....	2444
<i>S. Ali Mojahedi, J. Attari</i>	
<b>Beyond Compliance and toward Sustainability: Advantages of Systems Environmental Engineering</b> .....	2453
<i>Oral Saulters, Blase Leven, Larry Erickson, John Pickrell, Leslie Jamka, Ryan Green</i>	
<b>Environmental Impact of Coffee Processing Effluent on the Ecological Integrity of Rivers Found in Gomma Woreda of Jimma Zone, Ethiopia</b> .....	2462
<i>Y. K. Kebede, F. Assefa, A. Amsalu</i>	
<b>How to Save the Second Aral Sea?</b> .....	2472
<i>Rysbekov Yusup Khai</i>	

## **ENVIRONMENTAL TRACK POSTER SESSION**

<b>Air-Borne Heavy Metal Contamination to River Ganga (India)</b> .....	2480
<i>J. Pandey, K. Shubhashish, Richa Pandey</i>	
<b>The Effect of Sewage Pollutant of Bandar Imam Petrochemical Company on Benthic Macofauna Community Using Biodiversity Indices and Bioindicators</b> .....	2490
<i>Taybeh Tabatabaie, Fazel Amiri, M. B. Nabavi, M. Sh. Fazeli, M. Afkhami</i>	

## **LANDFILLS AND WASTE TREATMENT**

<b>Enzymatic Treatment of a Modified Food Processing Wastewater</b> .....	2499
<i>Anastasia E. M. Chirnside</i>	
<b>The Effect of Municipal Landfill Leachate on the Characterization of Fluid Flow through Clay</b> .....	2505
<i>S. Merayyan, A. Hope</i>	
<b>Time Series Analysis of Performance Data from Closed Landfills to Forecast Post Closure Monitoring Needs</b> .....	2520
<i>Banu Sizirici, Berrin Tansel</i>	
<b>Using Tracers to Derive Sediment Provenance after the Occurrence of a 500-Year Flood in a Midwestern Stream</b> .....	2530
<i>Kevin D. Denn, A. N. Papanicolaou, Christopher G. Wilson</i>	

## **NUTRIENTS IN THE ENVIRONMENT**

<b>Nitrification Inhibition by UVA Photocatalytic TiO<sub>2</sub> Nanoparticles: The Role of Reactive Oxygen Species on Nanotoxicity</b> .....	2540
<i>Okkyoung Choi, Zhiqiang Hu</i>	
<b>The Economic and Environmental Significance of Nonpoint Source Abatement in Large Watersheds</b> .....	2547
<i>Jamie Lefkowitz, Kirk Westphal, Jeffrey Walker, Gary Mercer</i>	
<b>The Nitrogen Budget of DRW in Northeastern China</b> .....	2557
<i>Chengwei Han, Shiguo Xu</i>	
<b>Wastewater Utilities: Are You Ready for Kansas' Nutrient Removal Policy?</b> .....	2566
<i>Heather Phillips, Katie Funderburk</i>	

## **SOIL AND SUBSURFACE REMEDIATION 1**

<b>Application of Biopile System for the Remediation of Petroleum-Hydrocarbon Contaminated Soils</b> .....	2575
<i>C. M. Kao, H. Y. Chien, Rao Y. Surampalli, W. P. Sung</i>	
<b>Peroxidase-Mediated Stabilization of 2,4-Dichlorophenol in a Model Humin-Mineral Geomaterial</b> .....	2585
<i>Mónica Palomo, Alok Bhandari</i>	
<b>pH Variation and Its Effect on Metal Concentration during Electrokinetics</b> .....	2590
<i>Ming Xiao, Ashleigh D. Love, Zheng Teng</i>	
<b>Pore-Scale Characterization of Residual Non-Aqueous Phase Liquids (NAPLs) in Fractional Wettability Porous Media</b> .....	2593
<i>Riyadh I. Al-Raoush</i>	

## **SOIL AND SUBSURFACE REMEDIATION 2**

<b>Addressing Contaminated Groundwater and Promoting Environmental Stewardship in Wichita, Kansas—The Gilbert and Mosley Project Story</b> .....	2603
<i>Paul Anderson, Shawn Maloney, Roger Olsen</i>	
<b>Use of In-Planta Solid Phase Sampling Devices to Delineate VOC Plumes</b> .....	2613
<i>Joel Burken, Kendra Waltermire, Emily Sheehan</i>	

### **SOIL AND SUBSURFACE REMEDIATION 3**

<b>Application of a Mass Balance-Based Subsurface Contaminant Transport Model</b> .....	2620
<i>Benjamin W. Johnson, Andrew Curtis Elmore, Jeffrey D. Cawlfeld</i>	
<b>Association of PAHs with Size Fractionated Sediment Particles</b> .....	2630
<i>Jejal Reddy Bathi, Robert Pitt, Shirley E. Clark</i>	
<b>Sorption and Desorption of Testosterone in Agricultural Soils</b> .....	2640
<i>Rui Ma, Tian C. Zhang</i>	

### **WETLAND MITIGATION AND WATER MANAGEMENT**

<b>A Study on Spatial Distribution of Water Quality and the Behavior of Do Concentration in Tidal Area of Urban Rivers</b> .....	2647
<i>M. Okabe, M. Kawamura, T. Kato, T. Yamada</i>	
<b>Development of an Amphibian Biotic Index to Evaluate Wetland Health in Northern Missouri</b> .....	2657
<i>C. D. Shulse, R. D. Semlitsch, K. M. Trauth</i>	
<b>GIS-Based Landscape Parameters for Wetland Evaluation Related to Amphibian Health</b> .....	2668
<i>Miriam Romero, Kathleen M. Trauth, Yingkui Li, Raymond Semlitsch, Christopher D. Shulse</i>	
<b>The Rush Creek Detention Facility: Planning a Permanent BMP in the Real World</b> .....	2678
<i>William Yord, Joe Ennett, Jerry Richardson</i>	

### **HYDROLOGICS AND WATERWAYS**

#### **BRIDGE SCOUR**

<b>General Hydraulic Characteristics of an Open Channel with Narrow Path</b> .....	2687
<i>M. S. Quimpo, T. Yamada</i>	
<b>Mathematical Modeling of Bed—Topography Changes at Bridge Abutments</b> .....	2697
<i>Omer Kose, A. Melih Yanmaz</i>	
<b>Predicting Rock Scour in an Alluvial River with a One-Dimensional Model</b> .....	2705
<i>Blair P. Greimann, Yong G. Lai, Kuowei Wu</i>	
<b>Predicting Rock Scour in an Alluvial River with a Two-Dimensional Model</b> .....	2714
<i>Yong G. Lai, Blair P. Greimann, Kuowei Wu</i>	

### **COMPUTATIONAL HYDRAULICS AND HYDRODYNAMICS I**

<b>3D Numerical Modeling of John Day Lock Tainter Valves</b> .....	2727
<i>E. Allen Hammack, Richard L. Stockstill</i>	
<b>A Three-Dimensional Numerical Model for Flow in a Lock Filling System</b> .....	2737
<i>Richard L. Stockstill, R. Charlie Berger</i>	
<b>Challenges on Three-Dimensional Simulations of Free Surface Flow</b> .....	2747
<i>Jinwei Qiu, Xing Fang</i>	
<b>Comparison of the Princeton Ocean Model and the Regional Ocean Modeling System Hindcasts in the Delaware River and Bay</b> .....	2757
<i>Richard A. Schmalz Jr.</i>	

### **COMPUTATIONAL HYDRAULICS AND HYDRODYNAMICS II**

<b>A Process-Based Unsteady Model for Wave-Current-Morphodynamic Changes in Two-Dimensions</b> .....	2772
<i>S. N. Kuiry, Yan Ding, Sam S. Y. Wang</i>	
<b>Simulation of Multilayer Shallow Water Fluid Flow Using Lattice Boltzmann Modeling and High Performance Computing</b> .....	2788
<i>K. R. Tubbs, F. T.-C. Tsai</i>	
<b>Two Dimensional Hydraulic Modeling of the Lower Skokomish River</b> .....	2796
<i>Cassie Klumpp</i>	
<b>Using Computational Model ADH to Evaluate Relationship of Water Surface Elevation to Wing Dikes</b> .....	2806
<i>Renjie Xia</i>	

### **COMPUTATIONAL HYDRAULICS AND HYDRODYNAMICS III**

<b>ADH = Fast and Stable 2D Finite Element Model</b> .....	2816
<i>Thomas Gambucci</i>	
<b>Evaluation of Methods to Reduce Backflows from the Chicago Waterway System to Lake Michigan</b> .....	2823
<i>Charles S. Melching, Emre Alp</i>	

<b>Modeling the Evolution of Incised Streams in Hammar Mesopotamian Marsh with Emphasis on the Contribution of Tidal Flow in the Filling Requirements .....</b>	<b>2833</b>
<i>A. H. Alkaabi, A. Ramamurthy, H. A. Al-Thamiry, A. A. Ali</i>	
<b>Numerical Simulations of Coastal Floods and Morphological Changes Due to Sea Level Rise and Hazardous Storm .....</b>	<b>2843</b>
<i>Yan Ding, Moustafa Elgohry, Sam S. Y. Wang</i>	

#### **COMPUTATIONAL HYDRAULICS AND HYDRODYNAMICS IV**

<b>Comparison of HEC-RAS and InfoWorks RS: A Case Study in Grand Prairie, Texas .....</b>	<b>2853</b>
<i>Thomas W. Mountz, Joshua Crowley</i>	
<b>Diversion of S-4 Basin Drainage from Lake Okeechobee: Hydraulic Modeling of Alternatives Using HEC-RAS .....</b>	<b>2863</b>
<i>Stephanie C. Otis, Gene L. Foster</i>	
<b>New Floodplain Delineation Capabilities in HEC-RAS .....</b>	<b>2873</b>
<i>Cameron T. Ackerman, Mark R. Jensen, Gary W. Brunner</i>	
<b>Transitioning NWS Operational Hydraulics Models from FLDWAV to HEC-RAS .....</b>	<b>2880</b>
<i>Fekadu Moreda, Angelica Gutierrez, Seann Reed, Cecile Aschwanden</i>	

#### **COMPUTATIONAL HYDRAULICS AND HYDRODYNAMICS V**

<b>Numerical Simulation of Dissolved Oxygen Concentration in the Downstream of Three Gorges Dam .....</b>	<b>2891</b>
<i>Xiangju Cheng, Xuewei Chen, Yongcan Chen</i>	
<b>On a Two-Dimensional Temperature Model: Development and Verification .....</b>	<b>2902</b>
<i>Yong G. Lai, David Mooney</i>	

### **VOLUME 5**

<b>Simulations of Aquaculture Dissolved Waste Transport and Mixing in Near-Coastal Waters .....</b>	<b>2916</b>
<i>S. K. Venayagamoorthy, O. B. Fringer, J. R. Koseff, R. L. Naylor</i>	
<b>The Importance of In-Stream Hydraulics in River Water Quality Models: Lessons from the Blackstone River .....</b>	<b>2924</b>
<i>Jeffrey D. Walker, Paula Sturdevant Rees, Thomas K. Walsh</i>	

#### **COMPUTATIONAL HYDRAULICS AND HYDRODYNAMICS VI**

<b>Inundation Mapping Using Hydraulic Models and GIS: Case Studies of Steady and Unsteady Models on the Tar River, NC .....</b>	<b>2933</b>
<i>Cécile Aschwanden, Seann Reed, Keren Cepero</i>	
<b>Performance Evaluation of Articulated Concrete Matting (ACM) Spillway at Lake Odessa, Iowa .....</b>	<b>2943</b>
<i>Thomas Gambucci</i>	
<b>The Development of a Neural-Based Biomarker Forecasting Tool for Classifying Recreational Water Quality .....</b>	<b>2951</b>
<i>Srinivas Motammarri, Dominic L. Boccelli</i>	
<b>Use of Hydraulic Modeling to Develop a Small Dam for the Geum River Reach in Sejong City .....</b>	<b>2959</b>
<i>Sangman Jeong, Christabel Jane Rubio, Joo-Heon Lee, Leehyung Kim, Kwangseob Shin</i>	

#### **COMPUTATIONAL HYDRAULICS AND HYDRODYNAMICS VII**

<b>An Efficient Solution for Water Supply Networks .....</b>	<b>2970</b>
<i>S. Engin Mendi</i>	
<b>Comparison of Mean Flow and Turbulence around Experimental Spur Dike .....</b>	<b>2977</b>
<i>Jennifer G. Duan, Li He</i>	
<b>Measuring Discharge with ADCPs: Inferences from Synthetic Velocity Profiles .....</b>	<b>2987</b>
<i>Chris R. Rehmann, David S. Mueller, Kevin A. Oberg</i>	
<b>Statistical Analysis of Water Distribution Networks Design Using Harmony Search .....</b>	<b>2996</b>
<i>Daniel Mora, Pedro L. Iglesias, F. Javier Martinez, Vicente S. Fuertes</i>	

#### **DAM OPERATION, MANAGEMENT, AND SAFETY I**

<b>Alternatives Study of Willwood Diversion Dam Siltation Removal in Wyoming, USA .....</b>	<b>3007</b>
<i>Hui-Ming Shih, Chih Ted Yang, Patrick F. Horn, Lynn C. Stutzman</i>	
<b>Managing Reservoir Discharge through Accurate Flow Measurement .....</b>	<b>3026</b>
<i>Bryan J. Heiner, Steven L. Barfuss</i>	
<b>Numerical Modeling of Flushing Process in Dez Dam Reservoir by HR Wallingford Method .....</b>	<b>3036</b>
<i>Ali Khosronejad, Afshin Ashrafzadeh, Majid Vazifedoust</i>	
<b>Simulation Study for Minimizing Diurnal Variation of Flow in a Hydroelectric Project to Reduce Downstream Impact .....</b>	<b>3043</b>
<i>Maya R. Ray, Arup Kr. Sarma</i>	

## **DAM OPERATION, MANAGEMENT, AND SAFETY II**

<b>Optimal Design and Operation of Fuse-Gates Considering Water Loss Due to Gates Tilting</b> .....	3053
<i>Abbas Afshar, Zeinab Takkiri</i>	
<b>The Effect of Step Height on Energy Dissipation in Stepped Spillways</b> .....	3061
<i>S. L. Hunt, K. C. Kadavy</i>	
<b>The Geneva Dam, IL, Hydraulic Roller Problem: Design of a Temporary Steep Riprap Ramp</b> .....	3072
<i>Yu-Chun Su, Loren Wobig, Brad Winters, Xin He, David T. Williams</i>	

## **ECO-HYDRAULICS**

<b>Fish Passage and Abundance around Grade Control Structures on Incised Streams</b> .....	3082
<i>J. T. Thomas, A. N. Papanicolaou, C. L. Pierce, D. C. Dermisis, M. E. Litvan, C. J. Larson</i>	
<b>Fish Passage Can Be Improved by Introducing Hydraulic Refuge: Can the Effects Be Quantified?</b> .....	3092
<i>Matthew D. Hays, Suzanne K. Monk, Trevor P. Hawkes, Joseph R. Webb, Rollin H. Hotchkiss, Mark Belk, Russell Rader</i>	
<b>Hydraulic Model Study of Canoe Chute and Fish Passage for the Chicago River North Branch Dam</b> .....	3107
<i>Jorge D. Abad, Andy Waratuke, Cristiana Barnas, Marcelo H. Garcia</i>	
<b>Some Findings on Effective Discharge Determination for Gravel Bed Rivers</b> .....	3118
<i>Carmen E. Bernedo</i>	

## **ECO-HYDRAULICS MODELING**

<b>Expanded Method for Filtering Submerged Objects in Echosounder Data</b> .....	3130
<i>Tim D. Osting</i>	
<b>Numerical Simulation of Chemical Spills Using CCHE2D Model and Chemical Property Database</b> .....	3136
<i>Xiaobo Chao, Tingting Zhu, Munther Hammouri, Yafei Jia</i>	
<b>One-Dimensional Modeling of Water Quality and Aquatic Ecosystems in Streams</b> .....	3149
<i>Podjane Inthasaro, Weiming Wu, Sam S. Y. Wang</i>	
<b>Use of Artificial Neural Networks for Habitat Unit Composition Modeling</b> .....	3159
<i>Jian-Ping Suen</i>	

## **ECO-HYDROLOGY**

<b>Considering River-Scale Ecological Improvements within Flood Management Planning: The Lower Menomonee River Watercourse Status Report</b> .....	3167
<i>Michael Schwar, Tom Chapman</i>	
<b>Developing Linkages between Biological Impairment and Stream Siltation: A Case Study in the Northern Great Plains Ecoregion</b> .....	3175
<i>John S. Schwartz, Andrew Simon, Lauren Klimetz</i>	
<b>The Effect of Natural Hydrological Disturbances (Defined from HSPF Simulated Hydrographs) on Trout Populations in Ungaged Streams of the Great Smoky Mountains National Park</b> .....	3186
<i>Keil J. Neff, Joseph Parker, John Schwartz, Matt Kulp, Steve Moore, Meijun Cai</i>	
<b>Upper Mississippi River Basin Envirohydrologic Observatory</b> .....	3196
<i>Jeremy Bril, J. V. Loperfido, Craig Just, Nathan Young</i>	

## **HYDRAULIC STRUCTURE**

<b>A Comparison of Formed Suction Inlets for Flood Control Applications</b> .....	3206
<i>David Werth, Mark Allen, Brent W. Nicholas</i>	
<b>Case Study: Impact of Varying Mitered Suction Elbows on Large Wastewater Pumps</b> .....	3215
<i>David Werth, Ted Stolinski</i>	

## **IN-STREAM STRUCTURES FOR HABITAT RESTORATION**

<b>Culvert Retrofit and Fish Passage: An Update</b> .....	3222
<i>Joseph R. Webb, Rollin H. Hotchkiss</i>	
<b>Field Evaluation of Engineered Large Woody Debris for Structure Performance and Habitat Value</b> .....	3234
<i>Kendra Russell, Elaina Holburn</i>	
<b>Numerical Analysis of the Performance of Rock Weirs: Effects of Structure Configuration on Local Hydraulics</b> .....	3244
<i>Christopher L. Holmquist-Johnson</i>	
<b>Quantitative Evaluation of Rock Weir Field Performance</b> .....	3256
<i>David Varyu, Kendra Russell, Elaina Holburn</i>	



## **LARGE RIVER HABITATS**

<b>A Digital Floc Camera for Nonintrusive Measurement of Floc Parameters</b> .....	3267
<i>Remya G. Kumar, Ariel Ruiz, Kyle B. Strom</i>	
<b>Multi-Criteria Assessment of Pallid Sturgeon Habitat Restoration for the Missouri River</b> .....	3273
<i>John Stansbury, Jennifer Gitt, Istvan Bogardi</i>	
<b>River Bed Sediment Classification Using ADCP</b> .....	3289
<i>F. Douglas Shields Jr.</i>	

## **LARGE RIVER RESTORATION**

<b>Environmental Aspects of Dredging: What About Air Quality?</b> .....	3300
<i>Mark J. Anderson, Brian D. Barkdoll</i>	
<b>Integrating Fluvial Geomorphology and Two-Dimensional Hydraulic and Sediment Transport Modeling to Support Sustainable Design of Large River and Floodplain Improvements: The Trinity River Corridor Project, Dallas, Texas, USA</b> .....	3310
<i>Mark R. Tompkins, Greg Ajemian, Gregory Welch, Anthony Falzone, Kyle Winslow, Paul Frank, Beatriz Dongell, Denny Mengel</i>	
<b>Rehabilitation of the Middle Rio Grande near Bernalillo, New Mexico</b> .....	3319
<i>Drew C. Baird, Carolyn Donnelly</i>	
<b>USACE River Ecosystem Restoration Planning: Lessons Learned from the Illinois River Study</b> .....	3332
<i>Michael Schwar</i>	

## **MODELING DAM BREACH**

<b>A Depth-Averaged 2-D Model of Non-Cohesive Dam/Levee Breach Processes</b> .....	3341
<i>Weiming Wu, Zhiguo He, Sam S. Y. Wang</i>	
<b>A Lattice Boltzmann Model for Dam Break Flows</b> .....	3351
<i>H. Liu, J. G. Zhou, R. Burrows, Y. Peng</i>	
<b>Comparison of Dam Breach Parameter Estimators</b> .....	3360
<i>D. Michael Gee</i>	
<b>Representation of Linear Terrain Features in a 2D Flood Model with Regular Cartesian Mesh</b> .....	3370
<i>Mustafa Altınakar, Marcus McGrath, Yavuz Ozeren, Edie Miglio</i>	

## **RISK UNCERTAINTY**

<b>Flood Risk Assessment of Complex Riverine Systems</b> .....	3380
<i>Christopher N. Dunn, Michael K. Deering</i>	
<b>Optimal Design of Water Diversion System: A Case Study</b> .....	3390
<i>Mohammad Karamouz, Siyamak Doroudi, Azadeh Ahmadi, Ali Moridi</i>	

## **RIVER STABILIZATION**

<b>Kansas River Bank Stabilization and Post-Project Conditions</b> .....	3400
<i>John Blancett, Pete Jarchow</i>	
<b>Adverse Effects of Flood Flow at Skewed Railroad Crossings</b> .....	3411
<i>William Yord, Jerry R. Richardson, Vincent J. Zink</i>	
<b>Physical Modeling of River Spanning Rock Structures: Evaluating Interstitial Flow, Local Hydraulics, Downstream Scour Development, and Structure Stability</b> .....	3419
<i>Kent L. Collins, Christopher I. Thornton, Brent Mefford, Christopher L. Holmquist-Johnson</i>	
<b>Redesign and Rehabilitation of Railroad Bridges with Advanced Adverse Lateral Migration</b> .....	3432
<i>William Yord, Jerry R. Richardson, Vincent J. Zink</i>	

## **SEDIMENT TRANSPORT MODELING I**

<b>A Direct Method for Determining Riprap Size for Erosion Protection in Rivers</b> .....	3437
<i>Yongliang Jin, Brian D. Barkdoll</i>	
<b>Modeling of Sediment Particle Deposition and Resuspension Processes Using a Stochastic Jump Diffusion Particle Tracking Model</b> .....	3441
<i>Jungsun Oh, Christina W. Tsai</i>	
<b>Numerical Model of Channel Meandering in the Middle Sacramento River</b> .....	3451
<i>Jianchun Huang, David R. Varyu, Blair P. Greimann</i>	
<b>One- and Two-Dimensional Modeling of Deep Gravel Mining in the Rio Salado</b> .....	3462
<i>Dong Chen, Mingfa Liu</i>	

## **SEDIMENT TRANSPORT MODELING II**

<b>Effects of Gas Ebullition on Cohesive Sediment Resuspension and Cap Stability .....</b>	<b>3471</b>
<i>Pinar Cakir Kavcar, Steven J. Wright</i>	
<b>Empirical Equation for Abrasion of Stilling Basin Caused by Impact of Sediment.....</b>	<b>3481</b>
<i>M. E. Banihabib, M. Elahi</i>	
<b>Investigation of Land-Use Change and Hydrologic Forcing upon Streambank Erosion and In-Stream Sediment Processes Using a Watershed Model and Sediment Tracers .....</b>	<b>3491</b>
<i>J. P. Russo, J. F. Fox, D. Martin</i>	
<b>Retrofitting Stormwater BMPs in a Supercritical Flow Regime: A Hydraulic Perspective.....</b>	<b>3506</b>
<i>I. J. Tye</i>	

## **SEDIMENTATION I**

<b>Numerical Simulation of Sediment Transport and Morphological Change of JiJi Weir Reservoir.....</b>	<b>3516</b>
<i>Yaixin Zhang, Yafei Jia, Keh-Chia Yeh, Chung-Ta Liao, Sam S. Y. Wang</i>	
<b>One-Dimensional Modeling of Sedimentation Processes on the Puyallup River .....</b>	<b>3528</b>
<i>Brian G. Wardman, Brad R. Hall, Casey M. Kramer</i>	
<b>Physical Experimentation and CFD Modeling to Evaluate Sediment Scour in Catchbasin Sumps .....</b>	<b>3538</b>
<i>Humberto Avila, Robert Pitt</i>	
<b>Sedimentation Characteristics of the Lower Nakdong River Upstream of the Nakdong River Estuary Barrage.....</b>	<b>3548</b>
<i>Sang-Kil Park, Un Ji, Byungdal Kim, Dohoon Kim</i>	

## **SEDIMENTATION II**

<b>Experimental Results on the Stability of Non-Cohesive Sediment Beds Subject to Vertical Pore Water Flux.....</b>	<b>3561</b>
<i>Pinar Cakir Kavcar, Steven J. Wright</i>	
<b>Suspended Sediment Concentration Measurements of Muddy Sediments with an ADV .....</b>	<b>3571</b>
<i>M. Salehi, K. B. Strom</i>	
<b>The Connectivity of Upland and Instream Processes .....</b>	<b>3578</b>
<i>Athanasios (Thanos) N. Papanicolaou, Philip Ellis</i>	
<b>Upstream Intrusion Effect of CSO Event in Bubbly Creek, IL .....</b>	<b>3588</b>
<i>Xiaofeng Liu, Sumit Sinha, Davide Motta, Marcelo H. Garcia</i>	

## **STREAM RESTORATION I**

<b>A Simple Analytical Design Method for Small Alluvial Channels.....</b>	<b>3599</b>
<i>Bruce M. McEnroe, John E. Shelley, C. Bryan Young</i>	
<b>Bankfull Discharge for Kansas Natural Alluvial Channel Design .....</b>	<b>3608</b>
<i>J. Shelley, C. B. Young, B. McEnroe</i>	
<b>Sediment Load Based Single Thread Alluvial Channel Classification .....</b>	<b>3614</b>
<i>Gregory Wilkerson, Gary Parker</i>	
<b>Using Watershed Scale Geomorphic Assessment to Improve Urban Stream Restoration Design .....</b>	<b>3625</b>
<i>Sue L. Niezgodna</i>	

## **STREAM RESTORATION II**

<b>Habitat Restoration on the Middle Fork John Day River .....</b>	<b>3635</b>
<i>E. R. Holburn, T. Turner, L. Piety, R. E. Klinger</i>	

## **VOLUME 6**

<b>Hungry Canyons Alliance: Streambed Stabilization in Western Iowa .....</b>	<b>3647</b>
<i>J. T. Thomas</i>	
<b>Rehabilitation of Mine Impaired Creek in Idaho .....</b>	<b>3657</b>
<i>Brian Murphy, Moosub Eom, Bill Adams, Jeff Johnson</i>	
<b>The Value of Protecting Ozark Streams: An Economic Evaluation of Stream Bank Stability for Phosphorus Reduction.....</b>	<b>3669</b>
<i>E. Dove, K. Rodgers, M. Keener</i>	

## **STREAM RESTORATION III**

<b>Developing Probability of Failure Estimates for Stream Restoration Design Components .....</b>	<b>3689</b>
<i>Timothy M. Sliwinski, Sue L. Niezgodna, Michael DeVasher</i>	

<b>Bedload Composition and Development of 2D Stream Sediment Model for Stream Restoration Design Applications in Urbanizing Watersheds</b> .....	3698
<i>William R. Cantrell, John S. Schwartz, William K. Barry</i>	
<b>Two-Dimensional BOD and DO Water Quality Model for Engineering Applications: The Case of Bubbly Creek in Chicago, Illinois</b> .....	3706
<i>Davide Motta, Jorge D. Abad, Xiaofeng Liu, Marcelo H. García</i>	
<b>Using HEC-RAS Hydraulic Design Functions for Geomorphic Channel Design and Analysis</b> .....	3721
<i>John Shelley, A. David Parr</i>	

#### **STREAM RESTORATION IV**

<b>A Monitoring and Assessment Framework to Evaluate Stream Restoration Needs in Urbanizing Watersheds</b> .....	3731
<i>John S. Schwartz, Sue L. Niezgod, Louise O. Slate, Donald D. Carpenter, William K. Annable, Tess M. Wynn, Christine Pomeroy, Munsell McPhillips</i>	
<b>Post Project Appraisal of Riparian, Wetland, and Aquatic Habitat Restoration at Best Slough, Beale Air Force Base, Marysville, CA</b> .....	3742
<i>M. R. Tompkins, D. Mengel, T. Hamaker</i>	
<b>Predicting Streambank Seepage Flows: Sensitivity to Soil Properties and Layering</b> .....	3752
<i>D. M. Heeren, G. A. Fox, M. L. Chu-Agor, G. V. Wilson</i>	
<b>A Seepage Erosion Sediment Transport Function and Geometric Headcut Relationships for Predicting Seepage Erosion Undercutting</b> .....	3762
<i>M. L. Chu-Agor, G. A. Fox, G. V. Wilson</i>	

#### **INTERNATIONAL**

##### **IMPROVING HYDROLOGIC PREDICTION IN DEVELOPING COUNTRIES**

<b>A Blueprint for Advancing Hydrologic Predictability in Developing Countries: A Case Study for the Nile River Basin</b> .....	3772
<i>M. Gebremichael</i>	
<b>Distributed Hydrologic Model for Flood Prevention in the Yuna River Water shed, Dominican Republic</b> .....	3781
<i>H. J. Robinson, Z. Fang, P. B. Bedient</i>	
<b>Evaluation of Land Use Land Cover Changes in Palleru (K-11) Sub Basin of River Krishna Using GIS and NDVI</b> .....	3788
<i>M. V. S. S. Giridhar, G. K. Viswanadh</i>	
<b>On the Local-Scale Spatial Variability of Daily Rainfall in the Highlands of the Blue Nile: Observational Evidence</b> .....	3800
<i>Menberu M. Bitew, M. Gebremichael, F. A. Hirpa, Y. Michael, Y. Seleshi, Y. Girma</i>	

##### **INTERNATIONAL WATER RESOURCES PLANNING AND MANAGEMENT**

<b>Characteristics of Integrated Water Resource Management in the Zambezi River and Great Lakes Basins: A Comparison of Two Approaches</b> .....	3809
<i>Jonathan W. Bulkeley, Imasiku Nyambe, Christine J. Kirchoff</i>	
<b>Determining the Causes of Declining Upper Great Lakes Levels—Phase I of the International Upper Great Lakes Study by the St. Clair River Task Team</b> .....	3819
<i>Anthony J. Eberhardt, Syed M. A. Moin</i>	
<b>Economic Sustainability Evaluation of an Inter-Basin Water Transfer Project Using GWP Statement</b> .....	3826
<i>Mohammad Karamouz, S. Ali Mojahedi, Asghar Elyasi, Vahid Askarnejad</i>	
<b>Recent Developments in Water Policy in the Americas</b> .....	3834
<i>Mark W. Killgore</i>	
<b>The Memorandum of Understanding (MOU) between the University of Zambia and the University of Michigan: Conception and Subsequent Implementation Goals</b> .....	3842
<i>Jonathan W. Bulkeley, Imaskiu Nyambe, Christine J. Kirchoff</i>	

##### **RURAL WATER SUPPLY SYSTEMS IN DEVELOPING COUNTRIES**

<b>Environmental and Water Resources in Developing Countries: Development of Micro Irrigation Facility at Parsoda Village</b> .....	3852
<i>P. K. Agale, N. N. Wankhede, P. B. Bhawe, S. Y. Mhaske</i>	
<b>Feasibility Study for Implementing Renewable Energy to Power a Groundwater Pump in Rural Guatemala</b> .....	3858
<i>Will Granich, Andrew Curtis Elmore</i>	
<b>Drinking Water Field Analyses for the Detection and Enumeration of Coliform Bacteria in Rural Guatemalan Highlands</b> .....	3868
<i>Jenna Tune, Andrew Curtis Elmore</i>	
<b>Sustainability of Rural Water Supply Projects in Nicaragua</b> .....	3876
<i>Jairo Hernandez Alvarado</i>	

## **TRANSBOUNDARY WATER ISSUES**

<b>Framework for Improving Water Security in the Middle East</b> .....	3886
<i>John A. Kliem</i>	
<b>A War for Water</b> .....	3896
<i>Jonah-Jong M. Lee</i>	
<b>Water Resources in Jordan: Challenges and Accomplishments</b> .....	3905
<i>S. Merayyan, S. Mrayyan, M. Mihyar</i>	

## **WATER QUALITY AND AQUATIC ECOSYSTEMS IN DEVELOPING COUNTRIES**

<b>Impacts of Mining in the Upper Zambezi River Basin: An Overview of the Zambian Copperbelt</b> .....	3916
<i>Imasiku A. Nyambe</i>	
<b>Improving the Water Quality of One of the World's Great Lakes: Tai Lake Case Study of Environmental Responsibility in the Developing World</b> .....	3926
<i>D. P. Albers</i>	
<b>Investigating Aquatic Ecosystems of Small Lakes in Khorezm , Uzbekistan</b> .....	3936
<i>Laurel Saito, Julian Scott, Michael Rosen, Bakhriddin Nishonov, Sudeep Chandra, John P. A. Lamers, Dilorom Fayzieva, Margaret Shanafield</i>	
<b>Prediction of Thermal Stratification in Proposed Bakhtyari Reservoir with CE-QUAL-W2</b> .....	3940
<i>Mehrdad Nazariha, Erfan Danaei, Seyyed Hosein Hashemi, Amir Hosein Izad Doustdar</i>	

## **IRRIGATION AND DRAINAGE**

### **CROP PRODUCTION AND WATER BALANCE**

<b>Physiological and Yield Response of Green Bell Pepper to Soil Moisture Sensor Controlled Drip Irrigation</b> .....	3948
<i>Lincoln Zotarelli, Michael D. Dukes</i>	
<b>Water Production Functions for High Plains Crops</b> .....	3958
<i>Thomas Trout, Gerald Buchleiter, Walter Bausch</i>	
<b>Water Retention and Hydraulic Conductivity of Different Media Used for Containerized Agriculture Systems</b> .....	3967
<i>Vivek Kumar, M. Reza Savabi, Felipe M. Guerrero, Berrin Tansel</i>	
<b>Water Use and Evapotranspiration Coefficients for Camelina Sativa</b> .....	3978
<i>D. J. Hunsaker, A. N. French, T. R. Clarke, D. M. El-Sheikha</i>	

### **CURRENT IRRIGATION SCHEDULING ADVISORY SYSTEMS 1**

<b>Irrigation Scheduling for Deficit Irrigation</b> .....	3988
<i>Norman L. Klocke, Loyd R. Stone, Dale A. Bolton</i>	
<b>The Arkansas Irrigation Scheduler</b> .....	3997
<i>Earl Vories, Phil Tacker, Steve Hall</i>	
<b>The Next Generation of Irrigation Management Programs</b> .....	4007
<i>P. M. Robinson</i>	
<b>Woodruff Irrigation Charts</b> .....	4016
<i>J. C. Henggeler</i>	

### **CURRENT IRRIGATION SCHEDULING ADVISORY SYSTEMS 2**

<b>A Web-Based Advisory Service for Optimum Irrigation Management</b> .....	4025
<i>Charles Hillyer, Marshall English, Carole Abourached, Chadi Sayde, Kent Hutchinson, John Busch</i>	
<b>Estimating Crop Coefficients from Fraction of Ground Cover and Height</b> .....	4035
<i>Richard G. Allen, Luis S. Pereira</i>	
<b>Manure Application to Soybeans in the Chesapeake Bay Watershed</b> .....	4050
<i>William F. Ritter</i>	
<b>On-Line Irrigation Scheduling within the Belle Fourche Irrigation District</b> .....	4057
<i>Jared K. Oswald, Hal D. Werner</i>	

### **DRAINAGE INFRASTRUCTURE AND NONPOINT SOURCES**

<b>Agricultural Drainage Management Systems Task Force (ADMSTF)</b> .....	4067
<i>James L. Fouss, Michael Sullivan</i>	
<b>Denitrifying Bioreactors for Treatment of Tile Drainage</b> .....	4077
<i>Laura E. Christianson, Alok Bhandari, Matthew H. Helmers, Martin St. Clair</i>	
<b>Drainage Main Rehabilitation in Iowa</b> .....	4087
<i>M. J. Helmers, S. Melvin, D. Lemke</i>	

## **ET IN WATER RIGHTS AND WATER TRANSFERS 1**

<b>Alfalfa Reference ET from a Weighing Lysimeter and Estimates from the ASCE Standardized Reference ET Equation in the Arkansas Valley of Colorado</b> .....	4092
<i>Allan Andales, Dale Straw, Thomas Ley, Abdel Berrada</i>	
<b>ASCE Standardized Penman-Monteith Alfalfa Reference ET and Crop ET Estimates for Arkansas River Compact Compliance in Colorado</b> .....	4101
<i>Thomas W. Ley, Dale E. Straw, Robert W. Hill</i>	
<b>Interstate Collaboration in the Arkansas River Compact Compliance Process: The “Nuts and Bolts” of Developing PET for Canal Service Areas for Input to the H-I Model</b> .....	4115
<i>Mary Kay Brengosz</i>	
<b>Overview of Development and Use of Crop ET Estimates with Hydrological Models for Interstate Compacts</b> .....	4128
<i>Dale E. Book, Mary Kay Brengosz</i>	

## **ET IN WATER RIGHTS AND WATER TRANSFERS 2**

<b>Adjusting Wind Speed Measured over Variable Height Alfalfa for Use in the ASCE Standardized Penman-Monteith Equation</b> .....	4140
<i>Thomas W. Ley, Richard G. Allen, Marvin E. Jensen</i>	
<b>Estimation of Evaporation and Evapotranspiration during Nongrowing Seasons Using a Dual Crop Coefficient</b> .....	4157
<i>Richard G. Allen, James L. Wright</i>	
<b>Evapotranspiration and Net Irrigation Water Requirements for Nevada</b> .....	4171
<i>J. L. Huntington, R. G. Allen</i>	
<b>Integrated Water Management in an Ancestral Water Scheme in a Mountainous Area of Southern Spain</b> .....	4186
<i>G. Vivas, E. Gómez-Landesa, L. Mateos, J. V. Giráldez</i>	

## **ET MEASUREMENT AND CALCULATION**

<b>Comparison of Sensible Heat Flux Measurements by a Large Aperture Scintillometer and Eddy Correlation Methods</b> .....	4195
<i>Xinhua Jia, Xiaodong Zhang, Dean D. Steele</i>	
<b>Mid-Summer Deficit Irrigation of Alfalfa as a Strategy for Saving Water</b> .....	4203
<i>B. R. Hanson, K. M. Bali, S. B. Orloff, B. L. Sanden, D. Putnam</i>	
<b>Recursive and Explicit Combination Methods for Calculating Reference Evapotranspiration</b> .....	4210
<i>C. H. Hay, S. Irmak</i>	
<b>Some Results of Evapotranspiration Measured by Three Weighing Lysimeters in La Mancha, Spain</b> .....	4220
<i>R. López-Urrea, A. Montoro, P. López-Fuster, F. Martín de Santa Olalla</i>	

## **IRRIGATION AND DRAINAGE ISSUES**

<b>Application of SIRMOD to Evaluate Potential Tailwater Reduction from Improved Irrigation Management</b> .....	4230
<i>Byron Clark, Lindsay Hall, Grant Davids, Wynn Walker, John Eckhardt</i>	
<b>Evaluation of Magnetic Meters for Irrigation Pipeline Measurement</b> .....	4241
<i>Stuart W. Styles, Bryan Busch</i>	
<b>Increasing Field Work Productivity in Irrigation Evaluation Processes through the Use of Combined Irrigation Models</b> .....	4249
<i>Sergio Lecina, Christopher M. U. Neale, Gary P. Merkley, Carlos A. C. dos Santos</i>	
<b>Neighborhood Channel is Redefined with Boulder Armoring</b> .....	4262
<i>Ted Niemann, John Loechle</i>	

## **LANDSCAPE IRRIGATION SCHEDULING AND WATER MANAGEMENT**

<b>Evaluation of Irrigation Scheduling Efficiency and Adequacy by Various Control Technologies Compared to Theoretical Irrigation Requirement</b> .....	4271
<i>Mary McCready, Michael D. Dukes</i>	
<b>Irrigation Rain Sensors Accuracy</b> .....	4290
<i>B. Cardenas-Lailhacar, M. D. Dukes, L. Meaks</i>	
<b>Preliminary Results for Bench Testing of Evapotranspiration-Based Irrigation Controllers in Florida</b> .....	4301
<i>Stacia L. Davis, Michael D. Dukes</i>	
<b>The Use of Soil-Water Sensors in Turf Irrigation Control—How Effective Are They?</b> .....	4312
<i>Garry L. Grabow, Michael Dukes, Bir Thapa</i>	

## **EVAPOTRANSPIRATION**

<b>Application of SVMs Algorithms for Prediction of Evaporation in Reservoirs</b> .....	4319
<i>Arun Goel</i>	

<b>Controlled Drainage Effects on Crop Yield and Water Use Efficiency under Semi-Arid Conditions of Iran</b> .....	4329
<i>Negar Sharifi Mood, Masoud Parsinejad, Farhad Mirzaei</i>	
<b>Estimation of Regional Reference Evapotranspiration from Land Surface Temperature and Co-Kriging Method at Tehran Province, Iran</b> .....	4337
<i>Mahdi Shahabifar, Maryam Chaichi, Mahdi Kouchakzadeh</i>	

### **REMOTE SENSING OF ET 1**

<b>Comparison of Evapotranspiration Estimates from Remote Sensing (SEBAL), Water Balance, and Crop Coefficient Approaches</b> .....	4346
<i>Bryan Thoreson, Byron Clark, Richard Soppe, Andy Keller, Wim Bastiaanssen, John Eckhardt</i>	
<b>Independent Comparisons among Calibration and Output of Energy Balance Components Estimated by the METRIC Procedure</b> .....	4361
<i>J. H. Kjaersgaard, P. H. Gowda, R. G. Allen, T. A. Howell</i>	
<b>Measuring Soil Moisture in a Heterogeneous Field</b> .....	4371
<i>Chadi Sayde, John Selker, Marshall English</i>	

## **VOLUME 7**

<b>Performance Evaluation of Soil Heat Flux Models in Great Plains</b> .....	4381
<i>R. K. Singh, A. Irmak, E. A. Walter-Shea, S. B. Verma</i>	

### **REMOTE SENSING OF ET 2**

<b>Application of Remote Sensing Based Tillage Mapping Technique to Evaluate Water Quality Impacts of Tillage Management Decisions in Upper White River Basin</b> .....	4391
<i>Shashank Singh, Indrajeet Chaubey, Prasanna H. Gowda</i>	
<b>Automated Selection of Anchor Pixels for Landsat Based Evapotranspiration Estimation</b> .....	4399
<i>J. H. Kjaersgaard, R. G. Allen, M. Garcia, W. Kramber, R. Trezza</i>	
<b>Mapping ET at High Resolution in an Advective Semi-Arid Environment with Airborne Multispectral Imagery</b> .....	4410
<i>J. L. Chávez, P. H. Gowda, T. A. Howell, L. A. Garcia, K. S. Copeland</i>	

### **LOCAL ISSUES – KANSAS CITY REGIONAL TOPICS**

<b>Brentwood Stream Restoration Project – Lenexa, Kansas</b> .....	4421
<i>Anthony Hall, Tom A. Jacobs</i>	
<b>Golden Eagle—Brown County, Kansas: Emergency Streambank Stabilization</b> .....	4429
<i>James M. Alexander</i>	
<b>Hutchinson, KS—4th and Carey Groundwater Remediation and Reverse Osmosis Water Treatment Facility Project</b> .....	4442
<i>Danita S. Boettner, Don Koci, Darren L. Brown, Bruce Allman</i>	
<b>Hutchinson, KS—4th and Carey Site Groundwater and Source Control Measures at Two Grain Elevators</b> .....	4452
<i>Darren L. Brown, Danita S. Boettner, Don Koci</i>	
<b>Impacts of Biota on Bioretention Cell Performance during Establishment in the Midwest</b> .....	4462
<i>A. M. Greene, S. L. Hutchinson, R. Christianson, T. L. Moore</i>	
<b>Importance of Levees in the Kansas City Area</b> .....	4475
<i>David W. Renetzky, John Grothaus</i>	
<b>Kansas City, Missouri Wet Weather Solutions Program: A Twelve Step Program</b> .....	4490
<i>Erin Ollig, Sheila Shockey</i>	
<b>Kansas City, MO Overflow Control Program: Line Creek/Rock Creek Sanitary Sewer Study</b> .....	4497
<i>Jeffrey W. Davies</i>	
<b>Lake Winnebago Dam Relocation Project</b> .....	4508
<i>Jonathan L. Polak, Shannon W. Tyree</i>	
<b>Zona Rosa and Rush Creek Conservation Area—Applied Ecology in a Mixed-Use Development</b> .....	4518
<i>J. J. Dremsa, D. M. Mensing</i>	
<b>Modeling Impacts of Conventional and Low Impact Stormwater Controls on Receiving Streams</b> .....	4525
<i>Elise Ibendahl, Dan Medina</i>	
<b>Potable Water from a Superfund Site?</b> .....	4535
<i>Marc Schlebusch</i>	
<b>Riverside-Quindaro Bend Levee (L-385) on the Missouri River: The Essential Role of O&amp;M and Documentation</b> .....	4545
<i>Gary W. Creason</i>	
<b>Protecting Infrastructure: Emergency Streambank Stabilization</b> .....	4555
<i>John Grothaus, Ken Markwell, Pete Jarchow, John Blancett</i>	
<b>The Impact of Smaller Detention Basins on Flood Hazard Areas in Lenexa, Kansas</b> .....	4570
<i>Elangovan Karuppasamy, Natalie Postel, Christine A. Pomeroy, Tom A. Jacobs</i>	
<b>Water Quality of Streams in Johnson County, Kansas, 2002-07</b> .....	4580
<i>T. J. Rasmussen</i>	

<b>Water-Quality Assessment of the Largely Urban Blue River Basin, Metropolitan Kansas City, USA, 1998 to 2007</b> .....	4589
<i>Donald H. Wilkison, Daniel J. Armstrong, Sarah A. Hampton</i>	

**PLANNING AND MANAGEMENT**

<b>A Bayesian Framework for Cost Effective Management of Sediment Reduction in the Minnesota River Basin</b> .....	4598
<i>Sarah K. Jacobi, Pearl Zheng, Benjamin F. Hobbs, Peter R. Wilcock</i>	
<b>A Decentralized Optimization Algorithm for Multi-Agent System Based Watershed Management</b> .....	4607
<i>Yi-Chen E. Yang, Ximing Cai, Dušan M. Stipanovi•</i>	
<b>A Decision Support System for Water Resources Planning and Management for the North Slope of Alaska</b> .....	4615
<i>Amy C. Tidwell, Kelly Brumbelow, Stephen F. Bourne, William E. Schnabel</i>	
<b>A Framework for Determining the Possible Impacts of a Changing Climate on Water Supply</b> .....	4622
<i>Mark Summerton, Roland Schulze</i>	
<b>A GIS-Based Decision-Making Methodology for Evaluation of Environmental Justice Impacts of Community Infrastructure Projects</b> .....	4633
<i>James S. Cole, Kathleen M. Trauth, Yingkui Li</i>	
<b>A Pragmatic Cycle for Ongoing Water Resources Research and Management</b> .....	4643
<i>Thomas L. Singleton, Stephen Bourne, Jack Hampson</i>	
<b>A Spatio-Temporal Drought Analysis for the Midwestern US</b> .....	4653
<i>Shih-Chieh Kao, Rao S. Govindaraju, Dev Niyogi</i>	
<b>Agent Based Models for Simulation of Watershed Sharing in a River Basin</b> .....	4663
<i>S. Mohan, K. Santhosh Kumar</i>	
<b>Analysis on Effect to EVW from Policy Intervention</b> .....	4673
<i>Ben-qing Ruan, Chun-ling Zhang, Cheng-li Wang, Feng-ran Xu</i>	
<b>Application of Genetic Algorithms for Estimation of Flood Routing Model Parameters</b> .....	4678
<i>S. Mohan</i>	
<b>Application of Multi-Objective Differential Evolution Algorithm (MDEA) to Irrigation Planning</b> .....	4688
<i>Josiah Adeyemo, Fred Otieno</i>	
<b>Assessing Potential Implications of Climate Change for Long-Term Water Resources Planning in the Lower Colorado River Basin</b> .....	4698
<i>Susan Butler, Armin Munevar, Ron Anderson, Joseph Rippole</i>	
<b>Asymptotic Variance of Regional Growth Curve for Generalized Logistic Distribution</b> .....	4707
<i>Hongjoon Shin, Woosung Nam, Younghun Jung, Jun-Haeng Heo</i>	
<b>Balancing the Budget: A Limited Detail Approach to Flood Studies</b> .....	4716
<i>Andrew J. Bonner</i>	
<b>Climate Flow Forecast Model for the Brazilian Hydropower System</b> .....	4726
<i>Mario T. L. Barros, João E. G. Lopes, Renato C. Zambon, Alberto L. Francato, Paulo S. F. Barbosa, Fabio R. Zanfelice</i>	
<b>Collaborative Groundwater Model Development</b> .....	4735
<i>David W. Barfield</i>	
<b>Communicating Drought Severity and Re-Evaluating Firm Yield—Cumberland County, Tennessee As a Case Study</b> .....	4738
<i>Lars Hanson, Stuart Stein</i>	
<b>Computer-Aided System for Managing, Controlling, and Analyzing Data from Hydroelectric Plants</b> .....	4748
<i>Ieda G. Hidalgo, Darrell G. Fontane, Secundino Soares Filho, Marcelo Augusto Cicogna</i>	
<b>Copula Approach for Reducing Uncertainty in Design Flood Estimates in Insufficient Data Situations</b> .....	4757
<i>Hemant Chowdhary, Vijay P. Singh</i>	
<b>Deriving Rule Curve for Hydropower Reservoirs: Seymareh Experience</b> .....	4771
<i>F. Sharifi, M. R. Jalali, R. Afzali</i>	
<b>Detection of Streamflow Trends and Variability in Karun River, Iran as Parts of Climate Change and Climate Variability</b> .....	4781
<i>Alireza Farrokhi, Ahmad Abrishamchi</i>	
<b>Developing Artificial Neural Networks to Represent Salinity Intrusions in the Delta</b> .....	4793
<i>Francis I. Chung, Sanjaya A. Seneviratne</i>	
<b>Developing Best Practices for Computer Aided Dispute Resolution</b> .....	4803
<i>S. Langsdale, L. Bourget</i>	
<b>Development of a Fuzzy Based Pipe Condition Assessment Model Using PROMETHEE</b> .....	4808
<i>Yi Zhou, Kala Vairavamoorthy, Frank Grimshaw</i>	
<b>Development of Regression Models to Estimate Flow Duration Statistics at Ungaged Streams in Oklahoma Using a Regional Approach</b> .....	4818
<i>Rachel A. Esralew</i>	
<b>Development of Sustainable Water Supply Scheme in Reservoir Operation: Case Study</b> .....	4831
<i>M. Karamouz, S. Nazif, S. Mohammadi</i>	
<b>Developments on Stochastic Analysis, Modeling, and Simulation (SAMS 2009)</b> .....	4839
<i>J. D. Salas, O. Sveinsson, T. S. Lee, W. Lane, D. Frevert</i>	
<b>Does Collaborative Modeling Lead to Better Management of Our Water Resources?</b> .....	4849
<i>S. Langsdale, W. Michaud</i>	
<b>Flow Augmentation for Dissolved Oxygen Improvement in Chicago Waterways</b> .....	4853
<i>Emre Alp, Charles S. Melching, Richard Lanyon</i>	

<b>Examining the Flow Regime Alteration and Its Potential Impacts to Freshwater Ecosystems under Changing Climate Conditions</b> .....	4863
<i>Jian-Ping Suen</i>	
<b>FEMA Flood Map Accuracy</b> .....	4874
<i>David R. Maidment</i>	
<b>Generating Different Scenarios of BMP Designs in a Watershed Scale by Combining NSGA-II with SWAT</b> .....	4884
<i>P. Kaini, K. Artita, J. W. Nicklow</i>	
<b>Hardening a Great and Growing City's Water Supply</b> .....	4893
<i>Scott Knight</i>	
<b>High Resolution Radar Precipitation Evaluation</b> .....	4904
<i>Dennis Miller, Shaorong Wu, David Kitzmiller, Feng Ding</i>	
<b>Hydrologic Modeling for Assessing Climate Change Impacts on the Water Resources of the Rio Conchos Basin</b> .....	4916
<i>Eusebio Ingol-Blanco, Daene C. McKinney</i>	
<b>Hydrological Feasibility of Environmental Flows in the Rio Grande/Bravo Basin</b> .....	4926
<i>Samuel Sandoval-Solis, Daene C. McKinney</i>	
<b>Impacts of the Upstream Storage Reservoirs on Itaipu Hydropower Plant Operation</b> .....	4937
<i>Mario T. L. Barros, Renato C. Zambon, João Eduardo G. Lopes, Paulo S. F. Barbosa, Alberto L. Francato, William W.-G. Yeh</i>	
<b>Inflow Forecasting for Real-Time Reservoir Operation Using Artificial Neural Network</b> .....	4946
<i>Taesoon Kim, Gian Choi, Jun-Haeng Heo</i>	
<b>Integrated Management of a Finite Water Supply in the Desert</b> .....	4955
<i>Daniel Wendell, Steve Shultz, Aditya Tyagi</i>	
<b>Long-Lead Forecasting of Monthly Rainfall Using Large Scale Climate Signals and Statistical Disaggregation Models</b> .....	4964
<i>Azadeh Ahmadi, Mohammad Karamouz, Sara Nazif, Navideh Noori</i>	
<b>Looking for a Solution—Joint Front Range Climate Change Vulnerability Study</b> .....	4974
<i>Alfredo Rodriguez, Larna Kaatz</i>	
<b>Managing Salinity in the Upper Santa Clara River System of California</b> .....	4982
<i>Nathan Brown, Brian Louie, Frank Guerrero, Terry Foreman, Sorab Panday, Vivek Bedekar, Jagjit Kaur</i>	
<b>Modeling Techniques to Incorporate Low Impact Development Features into Detention Analyses</b> .....	4992
<i>Kristin White, Jennifer J. Walker</i>	
<b>MOPSO in Multipurpose Operation of Single-Reservoir System</b> .....	5002
<i>E. Fallah-Mehdipour, O. Bozorg Haddad, M. A. Mariño</i>	
<b>Multi-Criteria Decision Making under Uncertainty in Rainfall-Runoff Calibration: A Fuzzy Compromise Programming Approach Based on Alpha Level Sets</b> .....	5011
<i>M. Shafii, F. De Smedt</i>	
<b>Multiobjective Differential Evolution and Differential Evolution for Irrigation Planning</b> .....	5021
<i>Piyush Gupta, A. Vasan, K. Srinivasa Raju</i>	
<b>Multireservoir Simulation Using Multipurpose Constraints and Object-Oriented Software Design</b> .....	5029
<i>Marcelo A. Cicogna, Darrell G. Fontane, Ieda G. Hidalgo, João E. Lopes</i>	
<b>Nonlinear Dependence in Hydrologic Time Series</b> .....	5040
<i>H. S. Kim, B. Sivakumar, E. T. Lee</i>	
<b>Paleo Pacific Ocean Sea Surface Temperature Variability and Upper Colorado River Basin Streamflow</b> .....	5050
<i>Oubeidillah A. Aziz, Glenn A. Tootle</i>	
<b>Planning for Climate Change</b> .....	5060
<i>John A. Kliem</i>	
<b>Probabilistic Streamflow Forecasts Based on Hydrologic Persistence in Central Texas</b> .....	5066
<i>Wenge Wei, David W. Watkins Jr.</i>	
<b>Providing a Physical Basis for Statistical Homogeneity in Regional Frequency Analyses</b> .....	5076
<i>Fredline Ilorme, Veronica W. Griffiths</i>	
<b>Reducing Uncertainty of Continuous Streamflow Predictions in Ungauged Basins (PUB) Using Regional Constraints: Using Regional Constraints for PUB</b> .....	5086
<i>T. Wagener</i>	
<b>San Joaquin River Restoration Program Monitoring and Management Plans</b> .....	5096
<i>J. Payne, D. Mooney</i>	

## VOLUME 8

<b>Selection of Overflow Control Strategies for the Austin Clean Water Program</b> .....	5106
<i>Joseph D. Smith, Eric D. Loucks</i>	
<b>Spatial Evolutionary Algorithms for Characterizing Large-Scale Spatial Groundwater-Vegetation Dynamics in Arid Region</b> .....	5114
<i>Jihua Wang, Ximing Cai, Albert J. Valocchi</i>	
<b>Study on the Water Value Conversion between Economy and Ecology and Countermeasures of Water Resources Distribution for Coordinated Development of Economy and Ecology</b> .....	5124
<i>Hongchen Ni, Hao Wang, Bo Zhao, Dangxian Wang</i>	
<b>The Implications of Discretizing Continuous Random Variables: An Example Using the U.S. Geological Survey Reporting Standards for Streamflow Data</b> .....	5136
<i>Stacey A. Archfield, Richard M. Vogel</i>	



<b>Uncertainty Analysis: You Need to Know What You Don't Know</b> .....	5142
<i>David T. Williams, Joseph D. Countryman</i>	
<b>Uncertainty and Sensitivity Analysis for Models with Calibrated Parameters</b> .....	5152
<i>Seung Uk Lee, Jery R. Stedinger</i>	
<b>Vulnerability of the Hydraulic Resources of the River Basin of the San Juan-Brave River with the Global Climatic Change</b> .....	5162
<i>Rodríguez García José Luis, Cardoso Landa Guillermo</i>	
<b>Water Demand Forecasting for the City of the Future against the Uncertainties and the Global Change Pressures: Case of Birmingham</b> .....	5172
<i>K. B. Khatri, K. Vairavamoorthy</i>	
<b>Water Quality Effects of Varying Crop, Fertilizer, and Carbon Prices</b> .....	5187
<i>T. L. Ng, J. W. Eheart, X. Cai</i>	
<b>Water Resources Planning under Non-Stationary Hydroclimate in a Snow Dominant Watershed</b> .....	5191
<i>Francis I. Chung, Tariq N. Kadir, Jefferey K. Galef</i>	
<b>Water Supply and Energy Generation</b> .....	5201
<i>L. K. Lampe, L. M. Adams, D. G. Jensen</i>	
<b>Watershed Management in the Indian Himalayan Region: Issues and Challenges</b> .....	5211
<i>Samagra Rana, Vaibhav Gupta</i>	
<b>Whatever It Takes: From Water Availability Model to Cost of Water</b> .....	5223
<i>Alfredo Rodriguez</i>	

## **STUDENT AND NEW PROFESSIONALS**

### **STUDENT AUTHOR COMPETITION WINNERS**

<b>Current Water Management Practices and the Effects of Climate Change on the Colorado River Basin</b> .....	5236
<i>J. Brandon Klenzendorf</i>	
<b>Does Polymer Have an Effect on Bacterial Regrowth in Anaerobically Digested Biosolids?</b> .....	5245
<i>Jean M. Ryan</i>	
<b>Effect of Acid Mine Drainage on Aluminum Release from Clay Minerals</b> .....	5252
<i>Oscar Vazquez</i>	
<b>Sensitivity Analysis of HEC-HMS Hydrologic Model to the Number of Sub-Basins: Case Study</b> .....	5260
<i>Osama Z. Al-Hamdan</i>	
<b>Study of Low Dosage Pre-Ozonation on Sand Filtration Efficiency</b> .....	5269
<i>Walter Lee Ellenburg</i>	
<b>The Dubai Palms: Construction and Environmental Consequences</b> .....	5276
<i>Ethan Poole</i>	

## **WATER, WASTEWATER, AND STORMWATER**

### **RETROFITTING STORMWATER BMPS**

<b>Developing Green Streets Prototypes to Reduce Combined Sewer Overflows for Cincinnati, Ohio</b> .....	5282
<i>Brian Marengo, Thomas Cahill, Daniel Wible, Courtney Marm, Ralph Johnstone</i>	
<b>Implementation and Performance of Stormwater Best Management Practice Retrofits in Wilmington, NC</b> .....	5292
<i>J. D. Wright, W. F. Hunt, M. R. Burchell II, C. A. Perrin, E. R. McCoy</i>	
<b>Modeling Stormwater Basins for Potential Retrofit Designs</b> .....	5302
<i>R. R. Headley, J. R. Wyrick</i>	
<b>Stormwater Infiltration Retrofits: Experience Gained through Long Term Monitoring</b> .....	5312
<i>R. G. Traver</i>	

### **STORMWATER RESEARCH I**

<b>A Tool for Determining Effectiveness and Whole Life Costs of BMPs</b> .....	5320
<i>C. C. Olson, L. A. Roesner, B. R. Urbonas</i>	
<b>Controlled Full-Scale Field Testing of an Up-Flow Filtration Device</b> .....	5333
<i>Noboru Togawa, Robert Pitt</i>	
<b>The Observed Effects of Stormwater Infiltration on Groundwater</b> .....	5342
<i>M. D. Machusick, R. G. Traver</i>	
<b>Water Quality Assessed by Benthic Macro-Invertebrates: Proposing the WQABI Method</b> .....	5352
<i>J. K. McNett, W. F. Hunt</i>	

### **STORMWATER RESEARCH II**

<b>A Robust and Fast Model for Simulating Street Flooding</b> .....	5363
<i>Arturo S. León, Leonardo S. Nanía, Arthur Schmidt, Marcelo H. García</i>	

<b>Evaluating the Mixing Mechanism of Outfall Discharges from Municipal Separate Storm Sewer Systems</b> .....	5373
<i>Michael H. Woo</i>	
<b>Physical Processes Resulting in Geyser Formation in Rapidly Filling Stormwater Tunnels</b> .....	5379
<i>Steven J. Wright, James W. Lewis, Jose G. Vasconcelos</i>	
<b>The “Silver Bullet”: Proprietary BMPs and Metropolitan St. Louis Sewer District’s Stormwater Program</b> .....	5389
<i>J. S. Hoskins, M. T. Buechter</i>	

**SECURITY ENHANCEMENTS IN WATER AND WASTEWATER UTILITIES 1**

<b>Survey of Water and Wastewater Utility Security Standards</b> .....	5398
<i>Dale Gabel, Yakir J. Hasit, Yaron Ben Ari</i>	

**SECURITY ENHANCEMENTS IN WATER AND WASTEWATER UTILITIES 2**

<b>Advances in Data Validation, Event Detection, and Communications Structures for a CWS: Case Study—Glendale, Arizona</b> .....	5404
<i>Kenneth A. Thompson, Rick Scott, Raja Kadiyala, Andreas Weingartner, Joep van den Broeke</i>	
<b>Implementing a Contamination Warning System at a Department of Defense Facility: Case Study—Port Hueneme, California</b> .....	5410
<i>Kenneth A. Thompson, Steve Fann, Raja Kadiyala, Yakir J. Hasit, Gary Jacobson</i>	

**CONCENTRATE MANAGEMENT IN DESALINATION 1**

<b>Concentrate Management and Disposal Practices in Australia</b> .....	5417
<i>James H. Jensen</i>	
<b>Desalination of Brackish Groundwater and Deep Well Injection of Concentrate in El Paso, Texas</b> .....	5427
<i>William R. Hutchinson</i>	
<b>Membrane Treatment of Rio Grande Water for Municipal Water Production during the Non-Irrigation Season</b> .....	5436
<i>Anthony J. Tarquin, Michael P. Fahy, John E. Balliew</i>	
<b>Synopsis of National Research Council’s Report on Desalination</b> .....	5446
<i>Sandeep Sethi</i>	

**CONCENTRATE MANAGEMENT IN DESALINATION 2**

<b>Cost Comparison of Membrane Treatment and Concentrate Management Practices at Drinking Water Treatment Plants in Florida</b> .....	5454
<i>Berrin Tansel, Irina Sosnikhina</i>	
<b>Desalination Concentrate: Bay vs. Ocean</b> .....	5461
<i>Patrick Treanor, Val S. Frenkel</i>	
<b>Future Water Supply Desalination Technology: Forward Osmosis Co-Located with Power Generation</b> .....	5471
<i>Tina Coop, Les Lampe</i>	
<b>New Strategies for Managing Desalination Concentrate with Zero Liquid Discharge from Two WRF Research Projects</b> .....	5477
<i>Rick Bond, Srinivas Veerapaneni</i>	

**WATER, WASTEWATER, AND STORMWATER TOPICS**

<b>A Mobile Emergency Drinking Water System Powered by Renewable Energy</b> .....	5487
<i>Matthew Vitello, Andrew Curtis Elmore, Mariesa Crow</i>	
<b>Adding Value to Sanitary Sewers—An Important Asset of Municipalities</b> .....	5497
<i>V. Firat Sever, Barton Bradshaw</i>	
<b>Ecosystem Services Approach to Public Facility Planning</b> .....	5508
<i>A. Yap, G. Honan, M. Kealy</i>	
<b>An Evaluation of Graywater Reuse Utilizing a Constructed Wetland Treatment System</b> .....	5518
<i>A. W. Jokerst, L. A. Roesner, S. E. Sharvelle</i>	
<b>Application of Enhanced Methods of Phosphorous and Nitrogen Removal from Wastewater</b> .....	5528
<i>Mohammad Reza Fallahpour, Mojtaba Fazeli, Seyed Ahmad Mirbagheri</i>	
<b>Bench-Scale Ozonation of Raw Industrial and Municipal Wastewater</b> .....	5537
<i>Richard O. Mines, Jr., Cary M. Oglesby, Laura W. Lackey</i>	
<b>Biological Nutrient Removal from On-Site Wastewater Treatment Systems Using a Membrane Aerated Bioreactor</b> .....	5549
<i>Zhihua Liang, Zhiqiang Hu</i>	
<b>Boundary Conditions for Simulating Complex Storm-Sewer Systems in Free Surface, Pressurized, and Mixed Flow Conditions</b> .....	5556
<i>Arturo S. León, Xiaofeng Liu, Mohamed S. Ghidaoui, Arthur R. Schmidt, Marcelo H. García</i>	
<b>City of St. Louis Permeable Pavement Alley Pilot Study</b> .....	5567
<i>Dave Yates, Marjorie Melton</i>	

<b>Competing Risks and the Development of Adaptive Management Plans for Water Resources: Field Reconnaissance Investigation of Risks to Fishes and Other Aquatic Biota Exposed to Endocrine Disrupting Chemicals (EDCs) in Lake Mead, Nevada, USA .....</b>	<b>5576</b>
<i>Greg Linder, Edward E. Little</i>	
<b>Construction of a Low-Flow Channel in Barber Creek: Case Study in the Powder River Basin, Wyoming .....</b>	<b>5601</b>
<i>Robert W. Thoman, J. J. Brown</i>	
<b>Decentralized Anaerobic Treatment of Blackwater: A Sustainable Development Technology Concept for Urban Water Management .....</b>	<b>5611</b>
<i>N. T. Gallagher, S. Sharvelle</i>	
<b>Development of a National GIS Database for Municipal Water and Wastewater Pipe Infrastructure System.....</b>	<b>5623</b>
<i>Sunil Sinha, Randy Dymond, Rahul Vemulapally, Thomas Dickerson, Seth Perry</i>	
<b>Engineering Natural Filtration Systems to Remove Selenium, Nitrate, and Bacteria from Impaired Surface Waters—Foundational Studies .....</b>	<b>5633</b>
<i>Ken Susilo, Eric Strecker, Randy Sundberg</i>	
<b>Extension of an LA-QUAL Model for Evaluating a Proposed Wastewater Discharge to Realistic Receiving Water Temperature and Flow Conditions.....</b>	<b>5646</b>
<i>Chris Herrington</i>	
<b>Gray Water and Treated Effluent Reuse.....</b>	<b>5658</b>
<i>Steven Roznowski, Kristofer Bruun, Larry Roesner</i>	
<b>Green Alternatives to Channel Stabilization.....</b>	<b>5668</b>
<i>Richard E. Besancon</i>	
<b>Hydraulic Modeling and Engineering Evaluation of Fort Myers Beach’s Water Distribution System .....</b>	<b>5674</b>
<i>Jinsheng Huo, Robert Garland, Doug Eckmann, Jack Green, Cathie Lewis</i>	
<b>Innovative Strategies Alleviate Water Stress in South East Queensland, Australia.....</b>	<b>5685</b>
<i>Hua Jiang, Scott Freeman, Jonathan Bates</i>	
<b>Multi-Objective Design of Transient Network Models .....</b>	<b>5694</b>
<i>Bong Seog Jung, Misgana Muleta, Paul F. Boulou</i>	
<b>Municipal Water Systems in the Columbia River Basin: A Portfolio Management Approach for Multiple Benefits .....</b>	<b>5704</b>
<i>Mark A. Anderson</i>	
<b>Reliability Based Design of Water Distribution Network (WDN) Considering the Reliability of Nodal Pressures.....</b>	<b>5713</b>
<i>N. Ghajarnia, O. Bozorg Haddad, M. A. Mariño</i>	
<b>Removal of Selenium and Nitrate from Surface Waters Using a Subsurface Microbial Filter.....</b>	<b>5722</b>
<i>Stephen Lyon, Scott Lynch, Imad Feghali, Randy Sundberg</i>	
<b>Research and Application of Activated Sludge Models .....</b>	<b>5730</b>
<i>Jinsheng Huo, Min Ji, Yan Jiang</i>	
<b>Risk Assessment to the Environment Due to Anionic Surfactants in Treated Sewages and Dried Sludges .....</b>	<b>5738</b>
<i>Arvind Kumar Mungray, Pradeep Kumar</i>	
<b>Riverbank Filtration for Water Supply: Indian Experience .....</b>	<b>5749</b>
<i>Pradeep Kumar, Indu Mehrotra</i>	
<b>Sustainable Design and Construction of Earthen-Dam Reservoirs for Water Produced in Association with Coalbed Natural Gas in the Powder River Basin, Wyoming .....</b>	<b>5758</b>
<i>J. J. Brown, Robert W. Thoman.</i>	
<b>Sustainable Development of Agriculture: Urban Waste Water a Viable Mean for Irrigation .....</b>	<b>5768</b>
<i>Chhedi Lal, Vaibhav Gupta</i>	
<b>Treatment Performance of Wastewater Lagoons in South Yungas Province of Bolivia.....</b>	<b>5796</b>
<i>Helen E. Muga, James R. Mihelcic, Nathan W. Reents, Santiago Morales, Gabriela Gemio, Meredith Ballard, Valerie J. Fuchs, Cara M. Hanson, Esther M. Johnson, Alison M. Hoyt</i>	
<b>Understanding and Controlling Fouling in Membrane Bioreactors .....</b>	<b>5808</b>
<i>Roger Babcock Jr.</i>	
<b>Using Media Filters in a Distributed Wastewater System Serving an Ecotourism-Oriented Development .....</b>	<b>5814</b>
<i>Kevin M. Sherman</i>	
<b>Water Treatment Industry Course Correction.....</b>	<b>5824</b>
<i>John A. Kliem</i>	

## VOLUME 9

### WATERSHED

### DEBRIS FLOW HAZARD ANALYSIS AND MODELING

<b>Associated Disasters to the Debris Flows .....</b>	<b>5829</b>
<i>Guillermo Cardoso-Landa</i>	
<b>Experimental Analyses of Sedimentation in the Slit Dam Reservoir.....</b>	<b>5841</b>
<i>Mohammad Ebrahim Banihabib, Ehsan Bahram</i>	

## **GREAT RIVERS OF THE WORLD**

<b>Geochemistry of Yukon and Copper River Tributaries, Alaska</b> .....	5853
<i>Melissa Carney, Andre Ellis, Thomas Bullen, Jeff Langman</i>	
<b>The Hydrology of the Congo River Basin: A GIS-Based Hydrological Water Balance Model</b> .....	5860
<i>J. Bahati Chishugi, B. F. Alemaw</i>	
<b>Preliminary Assessment of Planform Change at Low Flows with Vegetation Expansion: Platte River, Nebraska</b> .....	5876
<i>Lisa M. Fotherby</i>	
<b>Sediment Management for Shallow Water Habitat Creation on the Missouri River</b> .....	5886
<i>Michael Gossenaer</i>	

## **HYDROLOGIC MONITORING NETWORK**

<b>Design of Solar Radiation Sensor Network Using Geo-Statistical Methods</b> .....	5892
<i>Chandra S. Pathak, John R. Mecikalski, Ramesh S. Teegavarapu, Jayanthi Srikishen</i>	
<b>EPM Approach for Erosion Modeling by Using RS and GIS</b> .....	5902
<i>Fazel Amiri, T. Tabatabaie</i>	
<b>Evaluation of Improved Spatial Interpolation Methods for Infilling Missing Precipitation Records</b> .....	5909
<i>Alaa Aly, Chandra Pathak, Ramesh S. V. Teegavarapu, Jon Ahlquist, Henry Fuelberg</i>	
<b>Quantifying Uncertainty in Discharge Measurements: A New Approach</b> .....	5919
<i>J. E. Kiang, T. A. Cohn, and R. R. Mason Jr.</i>	

## **LAND USE/COVER CHANGES AND WATER QUALITY/QUANTITY**

<b>Assessment of Lumped, Quasi-Distributed and Distributed Hydrologic Models of the US Army Corps of Engineers</b> .....	5927
<i>Murari Paudel, E. James Nelson, Charles W. Downer</i>	
<b>Change in Surface Hydrology Due to Land Use Change in a Midwestern Watershed</b> .....	5938
<i>A. Spencer, B. Walker, M. Arabi, J. Frankenburger, R. S. Govindaraju</i>	
<b>Do Upland Soil Conservation Measures Reduce Watershed Sediment Yield?</b> .....	5948
<i>Jurgen D. Garbrecht, Patrick J. Starks</i>	
<b>Human Impact on the Mobilization of a Naturally-Occurring Source of Selenium in an Urbanizing Catchment</b> .....	5956
<i>Rachel Andrus, Barry Hibbs, Andre Ellis</i>	
<b>Long Term Effect of a Stream Restoration Plan on Water Quality</b> .....	5966
<i>Yuan Cheng</i>	
<b>Measurement of Velocity and Discharge of a Stream Using a New Floating Rod Equipped with a GPS Receiver</b> .....	5976
<i>W. Kim, C. Lee</i>	
<b>Prediction of Nitrate Concentration in Stream Water Based on Watershed Land Use and Stream Flow Rate</b> .....	5985
<i>Jingjie Teng, Mira Olson, Patrick Gurian, Anna Sofranko, Janet Herman, Aaron Mills</i>	
<b>Studying the Impact of Land Use/Cover Changes on the Water Quality of Weeks Bay, AL: Model vs. Regression</b> .....	5995
<i>Harsh Vardhan Singh, Latif Kalin, Graeme Lockaby</i>	

## **MISSISSIPPI RIVER BASIN**

<b>Modeling the Hydrology and Hydraulics of the Cache River System</b> .....	6005
<i>Misganaw Demissie, Laura Keefer, Yanqing Lian, Feng Yue, Elias Bekele</i>	
<b>The Mississippi River: A National Resource</b> .....	6015
<i>Nancy G. Bhowmik</i>	
<b>The Nature Conservancy's Mississippi River Program: Sustainable Conservation of a Working River that Works</b> .....	6023
<i>C. Stephen Haase, K. Douglas Blodgett</i>	

## **MODELING HYDROCLIMATE**

<b>Historical Reconstruction of Hydroclimatic Data Based on the Control Runs of GCMs over Sabah and Sarawak, Malaysia</b> .....	6027
<i>Noriaki Ohara, M. Levent Kavvas, ZhiQiang Chen, Ahmad Jamalluddin bin Shaaban</i>	
<b>Statistical Characteristics of Land Surface Properties for the Regional Hydroclimate Model</b> .....	6035
<i>S. Kure, S. Jang, N. Ohara, M. L. Kavvas</i>	

## **MODELING HYDROCLIMATE – STATISTICAL APPROACHES**

<b>Modeling the Kinematic Wave Parameters with Regression Methods</b> .....	6044
<i>I. Haltas</i>	
<b>On the Use of Data Uncertainty in Hydro-Climatic Modeling: A Bayesian Approach</b> .....	6054
<i>Shivam Tripathi, Rao S. Govindaraju</i>	

## **NEXRAD DATA ANALYSIS**

<b>Adjustment of the Z-R Relationship in Real-Time for Use in South Florida</b> .....	6064
<i>Amy Henschke, Emad Habib, Chandra S. Pathak</i>	
<b>Radar-Rainfall Analysis for Extreme August Storm in Sacramento</b> .....	6076
<i>David C. Curtis</i>	
<b>Use of Lightning and Storms Life Cycle Information in Radar Rainfall Estimation</b> .....	6087
<i>Emmanouil N. Anagnostou, Chandra S. Pathak, C. A. Morales</i>	
<b>Use of NEXRAD Rainfall Data to Develop Climatologically Homogenous Rain Areas for Central and South Florida</b> .....	6098
<i>Chandra S. Pathak, Matthew Onderlinde, Henry E. Fuelberg</i>	

## **NEXRAD DATA ANALYSIS AND APPLICATION**

<b>Impacts of Different Rainfall Estimates on Hydrological Simulation and Satellite Rainfall Retrieval Error Propagation</b> .....	6109
<i>Tadesse Meskele, Hamid Moradkhani</i>	

## **NEXRAD DATA APPLICATION TO HYDROLOGIC MODELING**

<b>Application of NEXRAD for Freshwater Inflow Estimates to Texas Bays and Estuaries</b> .....	6121
<i>Ruben S. Solis, Qingguang Lu</i>	
<b>Distributed Hydrologic Modeling: From Research to Operational Forecasting</b> .....	6134
<i>Michael Smith, Victor Koren, Ziya Zhang, Zhengtao Cui</i>	
<b>Flash Flood Forecasting for Ungauged Locations with NEXRAD Precipitation Data, Threshold Frequencies, and a Distributed Hydrologic Model</b> .....	6144
<i>Brian A. Cosgrove, Seann Reed, Feng Ding, Yu Zhang, Zhengtao Cui, Ziya Zhang</i>	
<b>Gauge-Based Adjustment of Historical Multi-Sensor Quantitative Precipitation Fields and Resulting Effects on Hydrologic Simulations</b> .....	6154
<i>Yu Zhang, Seann Reed, David Kitzmiller, Daniel Brewer</i>	

## **PREDICTION TOOLS IN WATERSHED MANAGEMENT**

<b>Estimating Probability of Extreme Events</b> .....	6166
<i>Jeff Harris, Gary Brunner, D. Michael Gee</i>	
<b>Prediction of Changes in Soil Moisture Due to Rainfall, Infiltration, and Evapotranspiration Using a Physically-Based Model</b> .....	6175
<i>Zhiguo He, Weiming Wu, Sam S. Y. Wang</i>	
<b>Reining in Log-Pearson Type III Flow-Frequency Estimates—Applying a Reasonable Bound through the Skew Parameter</b> .....	6186
<i>Ben Tustison, Joseph D. Countryman</i>	
<b>Understanding Water Quality Responses to Long-Term Acidic Deposition in a High-Elevation Southern Appalachian Watershed: A Focus on Soil Watershed Processes</b> .....	6198
<i>Meijun Cai, John S. Schwartz, R. Bruce Robinson, Steve E. Moore, Matt A. Kulp</i>	

## **PROBABILISTIC APPROACHES FOR WATERSHED PROCESSES 1**

<b>Estimation of TMDLs and Margin of Safety under Conditions of Uncertainty</b> .....	6210
<i>Mohamed M. Hantush</i>	
<b>Probable Maximum Precipitation for 24 Hour Duration over Four Central Provinces in Iran</b> .....	6220
<i>M. Naseri Moghaddam, S. Ghazanfari, B. Ghahraman, K. Davari</i>	
<b>Regional Regression Analysis and the Rational Method</b> .....	6226
<i>C. B. Young, B. M. McEnroe, A. C. Rome</i>	
<b>Stochastic Non-Equilibrium Bedload Transport Model</b> .....	6234
<i>Ken Z. Kuai, Christina W. Tsai</i>	

## **PROBABILISTIC APPROACHES FOR WATERSHED PROCESSES 2**

<b>Parameter Uncertainty Estimation of Hydrologic Models Using Bootstrap Resampling</b> .....	6243
<i>Mohammad Ebtehaj, Hamid Moradkhani</i>	
<b>Optimization of Regional Stormwater Quality Control Systems Using Genetic Algorithms</b> .....	6253
<i>Pradeep K. Behera, Ramesh S. V. Teegavarapu</i>	
<b>Statistical Seasonal Streamflow Forecasting: An Intercomparison and Evaluation of Current Forecasting Procedures</b> .....	6263
<i>Matthew Meier, Hamid Moradkhani</i>	

## **WATERSHED MANAGEMENT 1**

<b>Analysis of Water Quality Trends and Pollutant Loading for Cypress Creek Watershed</b> .....	6273
<i>A. Teague, H. Robinson, P. Bedient</i>	
<b>Assessment of the Capability of Hydrologic and Artificial Neural Network Models for Flood Warning System in Land Use Change Condition</b> .....	6283
<i>M. E. Banihabib, A. Arabi</i>	
<b>Estimating Groundwater Pumping and Return Flow Based on Hydrologic Recession Analysis</b> .....	6294
<i>Dingbao Wang, Ximing Cai</i>	
<b>Historical Changes in the Streamflow in Kansas Streams: Variation, Causes, and Implications</b> .....	6304
<i>Jonathan P. Aguilar, James K. Koelliker, Nicole Marie Dick</i>	
<b>Modeling Water Quality Impacts in Delaware’s Coastal Bays with AGNPS</b> .....	6314
<i>William F. Ritter, Bret A. Icenogle, Monika N. Meckley</i>	
<b>Parameterization of Seasonal Freshets for the Study of Effects of Freshwater Inflows on Galveston Bay</b> .....	6322
<i>Tony L. Smith, George H. Ward Jr., William H. Espey Jr., Richard Browning</i>	
<b>Runoffs of the Xiangride and Qaidum Rivers in the Arid Qaidum Basin, Northwest China</b> .....	6332
<i>S. Jia, S. Lin, Z. Sheng, R. Li, D. Liu, H. Yan, N. Feng</i>	

## **WATERSHED MANAGEMENT 2**

<b>Design and Implementation of Optimized Hydrologic Unit Watersheds for Rainfall-Runoff Modeling</b> .....	6342
<i>Ivan Rivas, Larry A. Roesner</i>	
<b>Effects of Rainfall-Runoff on Soil Surface Roughness and Erosion Processes</b> .....	6352
<i>D. C. Dermisis, A. N. Papanicolaou</i>	
<b>Hydrologic Modeling and Flood Frequency Analysis of the Sonora River Watershed in Sonora, Northwest Mexico</b> .....	6360
<i>Maureen L. Habarth, Brian D. Barkdoll</i>	
<b>Integrated Watershed Protection Plan and Management Strategy for the Calleguas Creek Watershed in Ventura County</b> .....	6370
<i>Kathleen Higgins, E. Zia Hosseini, Jeff Friesen</i>	
<b>McCormick Place West Hall Conference Center Stormwater Reclamation Tunnel and “Green Roof” Helps Advance Chicago’s Clean Water Agenda</b> .....	6380
<i>W. J. Weaver</i>	
<b>Spatial Variation of Sediment Oxygen Demand in Athabasca River: Influence of Water Column Pollutants</b> .....	6390
<i>Kusumakar Sharma, Preston McEachern, Mark Spafford, David Zhu, Tong Yu</i>	

## **WATERSHED MANAGEMENT 3**

<b>A Comparison of a SWAT Model for the Cannonsville Watershed with and without Variable Source Area Hydrology</b> .....	6402
<i>Josh Woodbury, Christine A. Shoemaker, Dillon Cowan, Zach Easton</i>	
<b>Effective Management of Natural Resources under Dry Land Farming through Watershed Basis</b> .....	6407
<i>Murukannappa, N. Indrakumar</i>	
<b>Evaluation of Uncertainties in the Simulation of Watershed Nutrient Load: A Case Study</b> .....	6412
<i>M. Karamouz, M. Taheriyoun, M. Seyedabadi, S. Behboodian</i>	
<b>Modeling Framework for Establishing Water Quality Trading Units near Pacific, Missouri</b> .....	6422
<i>Yee-Sook Shin, Kathleen M. Trauth</i>	
<b>Statistical Evaluation of BMP Effectiveness in Reducing Nutrient Impairment in Mermentau and Vermilion-Teche River Basins</b> .....	6431
<i>Z.-Q. Deng, H. Chowdhary</i>	
<b>Using “Big Data” to Optimally Model Hydrology and Water Quality across Expansive Regions</b> .....	6441
<i>Edwin A. Roehl Jr., John B. Cook, Paul A. Conrads</i>	

## **WATERSHED MODELING 1**

<b>Application of Northeast Regional Climate Center Research Results for the Purpose of Evaluating and Updating Intensity-Duration-Frequency (IDF) Curves—Case Study: Rochester, New York</b> .....	6456
<i>S. B. Wolcott, M. Mroz, J. Basile</i>	
<b>Assessment of Flood Risk Due to Storm Surge in Coastal Bayous Using Dynamic Hydraulic Modeling</b> .....	6465
<i>T. Ray, Z. Feng, P. B. Bedient</i>	
<b>Effects of Freezing and Thawing Processes on Bank Stability</b> .....	6475
<i>Fabienne Bertrand, A. N. Papanicolaou</i>	
<b>Integrated Surface Water and Groundwater Modeling of Orange River Basin in Southwest Florida for Flood Mitigation/Ecosystem Restoration</b> .....	6484
<i>E. Zia Hosseini</i>	
<b>Spatially Distributed Modeling of Soil Erosion and Sediment Transport at Watershed Scale</b> .....	6494
<i>H. Zeinivand, F. De Smedt</i>	
<b>The Role of the Clast Layer of Desert Pavement in Rainfall-Runoff Processes</b> .....	6504
<i>Li Chen, Jun Yin, Julianne Miller, Michael Young</i>	

<b>Watershed Models for Storm Water Management: Comparing Hydrologic and Hydraulic Procedures .....</b>	<b>6512</b>
<i>Deva K. Borah, Jamie H. Weist, Jack D. Wall, David N. Powell</i>	
<b>Water Subdivision for Modeling.....</b>	<b>6522</b>
<i>Theodore G. Cleveland, Thuy Luong, David B. Thompson</i>	

**WETLANDS**

<b>Integrated Watershed Modeling.....</b>	<b>6532</b>
<i>Gour-Tsyh Yeh, Guobiao Huang, Hsin-Chi Lin</i>	
<b>Understanding Uncertainties in Water Budget for Large Constructed Wetlands .....</b>	<b>6548</b>
<i>R. Scott Huebner, Chandra S. Pathak, Ramesh S. Teegavarapu</i>	
<b>Author Index</b>	