TECHNICAL SESSION MONDAY 11:15 – 12:45

BioSci 1102 *Water Quality*	**M11: Drinking Water Quality and Treatment Issues** Session Chair: *Dominic Boccelli*
	006 - Seasonal Temperature and Turbidity Behaviour in Trunk Mains. *Sunny, I., Husband, S.P., Boxall, J.B*. **015** - Transient Mobilisation of Replicated Biofilms. *Weston, S.L., Collins, R.P., Boxall, J.B*. **023** - Understanding Material Accumulation and Discolouration Risk in Distribution Networks. *Husband, S.P., Boxall, J.B*. **030** - Development of Assimilable Organic Carbon Assay and Field Application Within Drinking Water Treatment. *Pick, F.C., Fish, K.E., Moses, J.P., Boxall, J.B*. **046** - Monitoring Biofilm Communities in Operational Drinking Water Distribution Systems and the Impact on Water Quality. *Douterelo, I., Calero, C., Husband, S.P*.
BioSci 1103 *WDS Optimization*	**M12: Water Distribution Network Optimization, Planning and Design** Session Chair: *Marco Franchini*
	014 - Dynamic Clustering and a Hybrid Optimization for Roughness Calibration in Water Distribution Model. *Freitas, R., Brentan, B.M., Meirelles, G., Luvizotto Jr, E*. **019** - Many-Objective Optimal Meter Placement for Pipe Burst Detection. *Jung, D., Kim, J.H*. **026** - Improving Convergence Rate of NSGA II with Intermittent Feedback from Energy Based Methods for Design of Water Distribution Systems. *Paez, D., Salcedo, C., Avila, A., Filion, Y., Saldarriaga, J*. **028** - Directional Dependency of Minimum Variance of Flow Series in Looped Water Distribution Networks. *Rathi, S., Gupta, R., Ormsbee, L.E*. **024** - Correlation Analysis of Reliability Surrogate Measures in Real Size Water Distribution Networks. *Paez, D., Filion, Y., Suribabu, C.R*.
BioSci 1120 *Wastewater & Stormwater*	**M13: Wastewater/Stormwater Management and Modelling** Session Chair: *Dragan Savic*
	027 - Using Automatic Anomaly Detection to Identify Faults in Sewers. *Myrans, J., Kapelan, Z., Everson, R*. **035** - Performance Modelling of Etobicoke Exfiltration System (EES). *Joksimovic, D., Li, J.Y*. **048** - Evaluation of Sediment Transport in Sewers Using the EPR-MOGA-XL. *Montes, C., Berardi, L., Kapelan, Z., Saldarriaga, J*. **066** - An a Priori Evaluation of Measurement Campaigns in Urban Drainage Systems. *Vonach, T., Kleidorfer, M., Rauch, W., Tscheikner-Gratl, F*.

TECHNICAL SESSIONS MONDAY 11:15 – 12:45

Humphrey 102 *Demand Modelling*	**M14: Demand Modelling and Forecasting** Session Chair: *Mirjam Blokker*
	005 - Variation in Peak Water Demand with Building Size: Parameters and Methods. *Omaghomi, T., Buchberger, S.G*. **020** - Clothes Washing as Household End-Use: Comparison of Different Appliance Models in View of Expected Water Savings. *Botha, B.E., Jacobs, H.E., Terblanche, U*. **029** - Short-Term Water Demand Forecast Based on Deep Neural Network. *Guo, G., Liu, S*. **050** - Hybrid Wavelet and Local Approximation Method for Urban Water Demand Forecasting – Chaotic Approach. *Yousefi, P., Naser, G., Mohammadi, H*.
Humphrey 131 *Transients*	**M15: Transient Analysis in Water Distribution Networks** Session Chair: *Martin Lambert*
	036 - Research of Blockage Segment Detection in Water Supply Pipeline Based on Fluid Transient Analysis. *Xu, Y., Wu, Y., Chen, L., Guo, Y., Ding, W.W.Z*. **041** - Energy Analysis of Transient Frequency Shift Pattern Induced by Non-Uniform Blockages in Water Pipelines. *Che, T., Duan, H., Zheng, F., Pan, B., Lee, P.J*. **055** - An Efficient Lagrangian-Based Approach for Transient Modelling and Analysis in Urban Water Distribution Networks. *Huang, Y., Zheng, F., Duan, H., Zhang, Q., He, G*. **057** - Inverse Analysis of Pipe Viscoelastic Parameters Using Frequency-Domain Transient-Based Method. *Pan, B., Duan, H., Che, T., Zheng, F., Meniconi, S., Brunone, B*. **074** - Assessment of Hydraulic Transient Indicators in Water Supply Network. *Agostinho, M.S.P., Fernandes, C.V.S., Jung, B.S*.

TECHNICAL SESSIONS MONDAY 14:15 – 15:45

BioSci 1102 *Water Quality*	**M21: Drinking Water Quality and Treatment Issues** Session Chair: *Stewart Husband*
	061 - The Impact of Chlorine Concentration on the Discolouration Response of Biofilms in Drinking Water Distribution Systems. *Fish, K.E., Husband, S.P., Boxall, J.B*. **064** - Modelling Steady-State Biofilm in a Drinking Water Distribution System. *Blokker, M., van der Wielen, P.W.J.J*. **076** - Investigating the Impact of Sustained Low Pressure Events on Water Quality in Water Supply Networks Using Pressure-Driven Analysis. *Hatam, F., Besner, M., Prévost, G.E.M*. **115** - Patterns in the Deterioration of Water Quality in Distribution Networks with Demand Reduction Technologies. *Hook, J., Speight, V*.
BioSci 1103 *WDS Optimization*	**M22: Water Distribution Network Optimization, Planning and Design** Session Chair: *Bryan Karney*
	037 - Multi-Objective Optimal Design of Water Distribution Systems Using a Decomposition Approach. *Lee, H.M., Yoo, D.G., Kim, J.H*. **067** - Recommendations for the Adaptation Planning of Water Distribution Systems. *Parra, S., Krause, S., Angermair, G., Obermayer, B*. **102** - An Open Research Tool for Benchmarking and Dynamic Synthesis of Multi-Objective Evolutionary Algorithms for Optimal Design of Water Distribution Systems. *Wang, Q., Zhou, Z., Savić, D.A., Kapelan, Z*. **156** - A Comparative Study of Multi-Objective Methods for Sensor Placement Optimization Applied on Realistic WDN. *Cheifetz, N., Ramos-Castillo, M., Mandel, P., Féliers, C., Heim, V*.
BioSci 1120 *Wastewater & Stormwater*	**M23: Wastewater/Stormwater Management and Modelling** Session Chair: *Darko Joksimovic*
	056 - Sewer System Management Based on Online Monitoring and Model Analysis. *Jia, Y., Zheng, F., Fang, X., Qi, Z., He, G., Tao, R*. **125** - Statistical Modelling of Wastewater Pumping Stations Costs. *Cabral, M., Loureiro, D., Gomes, M., Oliveira, R., Covas, D*. **182** - Monitoring Seasonal Variations in Treatment Performance of a Wastewater Stabilization Pond with Algal Blooms and pH Fluctuations. *Liang, S., Hall, G., Champagne, P*. **185** - Three-Dimensional Simulation of Hydrodynamics and Water Quality in a Wastewater Stabilization Pond. *Mahyari, F., Rey, A., Boegman, L., Champagne, P., Mulligan, R., Hall, G., da Silva, A.M., Filion, Y*.

TECHNICAL SESSIONS MONDAY 14:15 – 15:45

Humphrey 102 *EPANET*	**M24: EPANET Open Source Project** Session Chair: *Kobus van Zyl*
	017 - The EPANET Open Source Initiative. *Salomons, E., Hatchett, S., Eliades, D.G*. **139** - Open Source SWMM and EPANET: Finally, a Written Invitation! *Hatchett, S., McDonnell, B.E., Mullapudi, A., Ratliff, K., Kerkez, B., Uber, J.G., Montestruque, L*. **160** - Results from the EWRI Summit on the Future of EPANET. *Murray, R., Grayman, W.M., Parsons, B., Whitten, B., Boccelli, D.L., Cleveland, T., Ostfeld, A., Strasser, A., Rowney, C*.
Humphrey 131 *Transients*	**M25: Transient Analysis in Water Distribution Networks** Session Chair: *Angus Simpson*
	077 - Analysis of the Frequency-Dependent Attenuation of Transient Pressure Waves in Plastic Pipes. *Gong, J., Stephens, M.L., Lambert, M.F., Zecchin, A.C., Simpson, A.R*. **079** - A Quasi-2D Unsteady Flow Model for Generalized Junction of the Pipe Network. *Kim, S., Kim, H*. **099** - Program of Controlled Transient Field Tests in Adelaide CBD Smart Network. *Stephens, M.L., Marchi, A., Gong, J., Lambert, M.F., Simpson, A.R*. **134** - The Problem of Air Valves Inaccurate Air Mass Flow Versus Differential Pressure Curves. *Tasca, E.S.A., Dalfré Filho, J. G., Luvizotto Junior, E., de Aquino, G.A*.
BioSci 1101 *Industry Experiences*	**M26: Industry Experiences** Session Chair: *Michael Hulley*
	223 - Collaborative Research with Large Water Utilities. *Wu, Z*. **106** - Transparent Water: From sensors to knowledge *Page, R., Blessing, M., Fink, N., Kunimünch, T.* **224** - Using Source Trace Analysis for Cost Sharing in Multiple-Municipality Water Supply Systems. *Hashemi, S., Long, A.*

TECHNICAL SESSIONS MONDAY 16:00 – 17:30

BioSci 1102 *Resilience & Reliability*	**M31: Resilience and Reliability of WDSs** Session Chair: *Juan Saldarriaga*
	022 - A Tool for Global Resilience Analysis of Water Distribution Systems. *Sweetapple, C., Diao, K., Farmani, R., Fu, G., Butler, D*. **031** - Application of Segment Based Robustness Assessment for Water Distribution Networks. *Hernandez, E., Ormsbee, L.E*. **075** - An Overview of the Water Network Tool for Resilience (WNTR). *Klise, K.A., Murray, R., Haxton, T*. **086** - Improving Water Distribution System Robustness Through Optimal Valve Location Approach. *Choi, Y.H., Jung, D., Kim, J.H*.
BioSci 1103 *WDS Modelling*	**M32: Water Distribution Network Modelling** Session Chair: *Enrique Cabrera*
	002 - Testing Pressure Dependent Demand at Low Pressure. *Walski, T., Havard, M., Yankelitis, B., Youells, J., Whitman, B.* **018** - Surrogate Models for the Simulation of Complex Water Supply Networks. *Krieg, H., Nowak, D., Bortz, M.* **025** - Performing Extended Period Simulation in EPANET Under Pressure Driven Demands. *Paez, D., Suribabu, C., Filion, Y.* **033** - Modeling of Control Valves in a Steady-State Water Distribution Network Simulation. *Weintrob, D*.
BioSci 1120 *Wastewater & Stormwater*	**M33: Wastewater/Stormwater Management and Modelling** Session Chair: *Yehuda Kleiner*
	200 - Dynamic Model of a Municipal Wastewater Stabilization Pond in the Arctic**.** *Kleiner, Y., Tartakovsky, B., Recio-Garrido, D., Colombo, A***.** **204 -** Impact of Control Structures on Hydraulic Retention Time in Wastewater Stabilization Ponds**.** *Rey, A., Mulligan, R., Boegman, L., Filion, Y., da Silva, A.M., Champagne, P***.** **206 -** Enhancing the Resilience of Interconnected Critical Infrastructures to Urban Flooding: An Integrated Approach**.** *Vamvakeridou-Lyroudia, L.S., Chen, A.S., Khoury, M., Gibson, M.J., Kostaridis, A., Stewart, D., Wood, M., Djordjevic, S., Savić, D.A***.** **222 -** Characterization and Evaluation of Water Purification with Varied Degrees of Pore Distributions**.** *Li, X., Gong, X***.**

TECHNICAL SESSIONS MONDAY 16:00 – 17:30

Humphrey 102 *Demand Modelling*	**M34: Demand Modelling and Forecasting** Session Chair: *Steven Buchberger*
	032 - Investigating the Influence of Weather on Water Consumption: a Dutch Case Study. *Xenochristou, M., Blokker, M., Vertommen, I., Urbanus, J.F.X., Kapelan, Z*. **053** - Do Time Series Models Contribute to Water Demand Clustering? *Oliveira, P.J.A., Boccelli, D.L*. **065** - Drinking Water Demand Under Stressed Conditions; Quantification with SIMDEUM. *Blokker, M., Agudelo-Vera, C., Mesman, G., de Jong, S., Adamse, E*. **112** - Impacts of the Integration of Water Demand Prediction in Real Time Control of Water Distribution Systems. *Doghri, M., Duchesne, S., Poulin, A., Ouellet, M*.
Humphrey 131 *Transients*	**M35: Transient Analysis in Water Distribution Networks** Session Chair: *Olivier Piller*
	147 - Propagating Uncertainties in Hydraulic Transient Modelling Using a Non-Intrusive Polynomial Chaos Methods. *Kazemi, E., Collins, R.P*. **149** - Estimation of Marginal Time in Water Distribution Systems for Valve Closure Considering Transient Flow Effects. *Carvajal, J.D., Bohorquez, J*. **168** - Comparison of One-Dimensional Unsteady Flow Models. *Nault, J.D*. **183** - Comparing Pure CFD and 1-D Solvers for the Classic Water Hammer Models of a Pipe-Reservoir System. *Mandair, S., Karney, B., Magnan, R., Morissette, J*.
BioSci 2109 & 2111 *EPANET*	**M36: Short Course on Open Source Coding for the EPANET Project** Session Chair: *Elad Salomons & Sam Hatchett*
	In this informal workshop-style session, participants will learn the basics of online software collaboration, connect with the EPANET development community and gain confidence in interacting with other developers. The main focus will be on the EPANET engine (also known as the DLL or Toolkit API) but we will also discuss the graphical user interface (GUI) and opportunities for development and collaboration on that project. **Bring your own computer.**

TECHNICAL SESSIONS TUESDAY 11:15 – 12:45

BioSci 1102 *Water Quality*	**T11: Drinking Water Quality and Treatment Issues** Session Chair: *Richard Collins*
	094 - Analysis of Relations Between Pressure and Water Age in Water Distribution Systems. *Chen, J., Zeidan, M., Ostfeld, A., Geletu, A., Li, P*. **119** - Experiment and Simulation of Ferrous Ions Diffusion at the Dead-End Branch Pipes of Water Distribution System. *Gao, J., Hu, S., Wu, W., Li, Y., Jian, C., Li, J., Ding, J., Cui, M., Zou, S*. **161** - Optimising Flow Conditioning in Operational Trunk Mains for Discolouration Risk Reduction and Maintaining Network Resilience. *Al-Saffar, M., Husband, S.P*. **189** - Monte Carlo Simulation of Velocity as Water Quality Indicator in Distribution Networks. *Gibson, J., Guo, Y., Karney, B*. **171** - Optimal Water Supply Pump Operation Considering Disinfection Performance. *Hyung, J.S., Seo, J.W., Kim, K.B., Kim, T.H. Koo, J.Y.*
BioSci 1103 *WDS Optimization*	**T12: Water Distribution Network Optimization, Planning and Design** Session Chair: *Shuming Liu*
	110 - Life Cycle Cost-Based Pipe Replacement Model and Application in Depopulation Scenario. *Hasegawa, K., Arai, Y., Koizumi, A*. **111** - A Hybrid Method for Calibration of Unknown Partially/Fully Closed Valves in Water Distribution Systems. *Do, N.C., Simpson, A.R., Deuerlein, J., Piller, O*. **133** - An Hourly Time Step Optimization Model of a Regional Water Supply System in Aquator Environment – A Case Study. *Arena, C., Cannarozzo, M., Fortunato, A., Lombardo, A., Scolaro, I., Mazzola, M*. **140** - Generating Heuristics to Mimic Experts in Water Distribution Network Optimisation. *Walker, D.J., Johns, M.B., Keedwell, E., Savić, D.A*. **040** - Improving Energy Efficiencies in WDN with EPANET Based Tools. *Gómez, E., del Teso, R., Cabrera, E., Estruch, E.*
BioSci 1120 *Leakage*	**T13: Leakage Management, Detection and Modelling** Session Chair: *Kobus van Zyl*
	001 - Hydraulic and Economic Analysis of Real Time Control. *Walski, T., Creaco, E*. **021** - Leakage Modeling Through Empirical Equations: An Experimental Approach. *Braga, A.S., Fernandes, C.V.S., Braga, S.M., Santos, D.C*. **043** - Leak Detection and Localization Based on Search Space Reduction and Hydraulic Modelling. *Sophocleous, S., Savić, D.A., Kapelan, Z., Gilbert, C., Sage, P*. **108** - An Experimental Study for Leak Detection in Intermittent Water Distribution Networks. *Mohandoss, P., Bhallamudi, S.M., Narasimhan, S., Narasimhan, S*. **095** - Clustering and Multi-Objective Operation of Water Distribution Systems: Water Age, Leakage and Cost Trade-Off. *Zeidan, M., Chen, J., Geletu, A., Li, P., Ostfeld, A.*

TECHNICAL SESSIONS TUESDAY 11:15 – 12:45

Humphrey 102 *Demand Modelling*	**T14: Demand Modelling and Forecasting** Session Chair: *Heinz Jacobs*
	136 - Node Grouping for Consumer Demand Estimation Using a Self-Organizing Map. *Rana, S.M.M., Boccelli, D.L., Marchi, A., Dandy, G.C*. **148** - Re-Evaluating South Africa'S Guidelines for the Provision of Water for Fire-Fighting. *Bean, C.M., Ilemobade, A*. **187** - Modeling and Forecasting Short-Term Water Demand Reported by Smart Meters. *Pesantez, J.E., Berglund, E.Z., Kaza, N*. **202** - Combining Surveys and Flow Logger Data to Improve the Accuracy of End-Use Segregation of Residential Water Consumption. *Wills, P., Memon, F.A., Savić, D.A., Merchant, P.M., Roberts, M., Nankervis, J., Martin, A*. **218** - Household Hot Water Temperature – An Analysis at End-Use Level. *Jacobs, H.E., Botha, B.E., Blokker, M*.
Humphrey 131 *Energy in WDSs*	**T15: Energy Management in WDSs** Session Chair: *Yves Filion*
	039 - Improving Energy Efficiencies in WDN with EPANET Based Tools. *Gómez, E., del Teso, R., Cabrera, E., Estruch, E*. **045** - Residential Water and Energy Savings in Right-Sized Premise Plumbing. *Omaghomi, T., Buchberger, S.G*. **114** - Assessing the Impact of Network Layout on Energy Efficiency, Water Losses and Water Quality in Water Supply. *Mamade, A., Monteiro, L., Maricato, N., Alves, Z., Loureiro, D., Covas, D*. **127** - Pump Performance & Energy Efficiency Testing & Benchmarking. *Papa, F., Radulj, D., Nault, J.D*. **166** - Potentially Recoverable Energy Assessment in Water Distribution Networks. *Iglesias-Castelló, M., Iglesias-Rey, P.L., Martínez-Solano, F.J*.

TECHNICAL SESSIONS TUESDAY 14:15 – 15:45

BioSci 1102 *Water Quality*	**T21: Drinking Water Quality and Treatment Issues** Session Chair: *Joby Boxall*
	194 - West Cumbria Chlorine Decay Modelling. *Rimmer, C*. **209** - Examining the Role of Layer Growth Duration on Layer Strength and Turbidity Response in a Full-Scale Laboratory Drinking Water Distribution System at Queen's University. *Saulnier, R., Filion, Y*. **211** - Flow Related Turbidity Distribution Over the Height of a Main. *Schaap, P*. **212** - Modeling of Dispersion Effect for Intermittent Flow in Premise Plumbing Systems. *Woo, H., Burkhardt, J., Rossman, L., Mason, J., Murray, R*.
BioSci 1103 *WDS Optimization*	**T22: Water Distribution Network Optimization, Planning And Design** Session Chair: *Zoran Kapelan*
	121 - Drinking Water Network Optimization of Montreal. *Lamarre, J*. **175** - Optimal Design of District Metered Areas Based on Graph Theory and Multi-Objective Optimization. *Liu, J., Lansey, K.E*. **208** - PST: A Tool for Optimum Pump Scheduling of Water Systems. *Muhammed, K., Farmani, R., Cisternas, L.A., Araya, N*. **130** - A Practical Application of WDNETXL System to DMA Design of Apulian Networks. *Spagnuolo, S., Perrone, G., Berardi, L., Laucelli, D., Simone, A.3, Giustolisi, O*.
BioSci 1120 *Leakage*	**T23: Leakage Management, Detection and Modelling** Session Chair: *Orazio Giustolisi*
	080 - Influence of Disinfectant Corrosion on Loss of Leak Openings on Different Pipe Materials in Water Supply Network. *Jian, C., Gao, J., Li, Y., Hu, S., Ding, J., Cui, M., Yao, F., Zou, S*. **100** - District Metering Areas and Pressure Reducing Valves Trade-Off in Water Distribution System Leakage Management. *Lifshitz, R., Ostfeld, A*. **107** - Leakage Separation in Multi-Leaks Pipe Networks Based on Improved Independent Component Analysis with Reference (ICA-R) Algorithm. *Li, Y., Gao, J., Wu, W., Jian, C., Hu, S., Li, J., Ding, J., Cui, M., Zou, S*. **058** - Planning Models for Optimal Deployment of Water Leak Sensors and Their Effectiveness. *Nam, Y., Arai, Y., Koizumi, A., Kunizane, T*.

TECHNICAL SESSIONS TUESDAY 14:15 – 15:45

Humphrey 102 *History of WDS Modelling*	**T24: The History of WDSs Modelling** Session Chair: *Walter Grayman*
	004 - Water Distribution System Analysis Before the Digital Age. *Walski, T*. **010** - The Evolution of Water Distribution Models. *Ormsbee, L.E*. **009** - History of Optimization in Water Distribution System Analysis. *Savić, D.A., Mala-Jetmarova, H., Sultanova, N*. **013** - History of Water Quality Modeling in Distribution Systems. *Grayman, W.M*.
Humphrey 131 *Water & Climate*	**T25: Climate Change and Urban Water Management, Water Supply and Water Scarcity.** Session Chair: *Lydia Vamvakeridou-Lyroudia*
	131 - Building Awareness and Active Citizen Participation for Water Challenges. *Strzelecka, A., Riley, J., Ozawa-Meida, L., Becker, M., Pianosi, M., Eleman, R., Thompson, P., Cameron, A., Coles, D., Draper, J., Ballard, C., Fleming, P., Chauhan, D*. **158** - Forecasting Pollutant Concentration in River to Protect Drinking Water Production. *Cheifetz, N., Laradi, M., Fauchon, N., Thouvenel, F., Féliers, C., Heim, V*. **201** - Water Distribution System Capacity Under Uncertain Climate Change. *Roshani, E., Kleiner, Y., Colombo, A*. **207** - Serious Gaming to Explore the Water-Energy-Food-Land-Climate Nexus with Multi-Stakeholder Participation: The Sim4Nexus Approach. *Sušnik, J., Mereu, S., Trabucco, A., Evans, B., Khoury, M., Luchner, J., Domingo, X., Vamvakeridou-Lyroudia, L.S., Chew, C., Savić, D.A., Laspidou, C., Brouwer, F*.

TECHNICAL SESSIONS TUESDAY 16:00 – 17:30

BioSci 1102 *Resilience & Reliability*	**T31: Resilience and Reliability of WDSs** Session Chair: *Luigi Berardi*
	179 - Incorporating Decision-Maker Preferences into the PADDS Multi-Objective Optimization Algorithm for the Design of Water Distribution Systems. *Tolson, B.A., Jahanpour, M*. **165** - Placement of Isolation Valves for Resilience Management of Water Distribution Systems. *Meng, F., Sweetapple, C., Fu, G., Farmani, R., Butler, D*. **170** - An Application of the A-PDA Model for the Interconnected Operation Among Adjacent Blocks of Water Distribution Systems in Case of Emergency. *Oak, S., Kim, S., Jun, H*. **178** - Detectability-Based Resilience of Water Distribution System Using Failure Finger Print. *Lee, S., Shin, S., Burian, S., Judi, D., McPherson, T*.
BioSci 1103 *WDS Modelling*	**T32: Water Distribution Network Modelling** Session Chair: *Lindell Ormsbee*
	089 - Application of Distributed Pressure Driven Modelling in Water Supply System. *Menapace, A., Righetti, M., Avesani, D*. **116** - Modified Newton-Raphson Technique for Integrated Object-Oriented Water Pipe Network Analysis. *Jha, K., Mishra, M.K*. **132** - Heuristic Approach to Optimisation of Utility – Service Provision. *Strzelecka, A., Ulanicki, B., Ozawa-Meida, L*. **141** - How to Infer Prior Knowledge in Water Distribution Data-Driven Models? *Brentan, B.M., Laurain, V., Aberkane, S*.
BioSci 1120 *Leakage*	**T33: Leakage Management, Detection and Modelling** Session Chair: *Cristovão Fernandes*
	129 - Feasibility Study of a Micro Turbine-Powered Pressure Sensor for Leak Detection and Leak Localization. *Pointl, M., Pertl, S., Fuchs-Hanusch, D*. **144** - Use of Spectrometer for Detection of Leaks in Water Distribution System. *Aslam, H., Karunagoda, P., Quadri, M.S., Slim, M.M.A., Hammodat, A.R., Nabulsi, M.A., Mortula, M.M., Ali, T*. **146** - LeakDB: a Benchmark Dataset for Leakage Diagnosis in Water Distribution Networks. *Vrachimis, S.G., Kyriakou, M.S., Eliades, D.G., Polycarpou, M.M*. **069** - Application of Water Consumption Smart Metering for Water Loss Assessment: A Case Study. *Alvisi, S., Franchini, M., Luciani, C*.

TECHNICAL SESSIONS TUESDAY 16:00 – 17:30

Humphrey 102 *Future of WDS Research*	**T34: Envisioning the Future of Water Distribution and Supply** Discussion Moderators: *ASCE Water Distribution Systems Committee*
	Improvements in monitoring and treatment and impending water shortages are spurring a re-imagination of the water supply system structure to be more resilient and cost-effective. The power of sensor systems, data integration, data analysis, and computational tools can transform water system management in the decades ahead. This session will be an audience-driven discussion on envisaging the future of water supply infrastructure and control. The conversation will center on: **1.** What will the WDS/Water Supply Infrastructure look like in 2035? In 2060? **2**. How will increasing demands, decreasing supplies, societal decisions and regulatory constraints impact the manner water is supplied in 2035? In 2060? **3.** What WDS/water supply system data will be collected and how will it be analyzed and used for WDS management in 2035? In 2060?
Humphrey 131 *SMART Systems*	**T35: Smart Water Systems** Session Chair: Perter van Thienen
	003 - Use of Smart Tools for Model Build and Verification in Ireland. *Reynolds, S*. **078** - Identification, Prediction, and Explanation of Outdoor Residential Water Consumption Using Smart Meter Data. *Platsko, V., van Beek, P*. **084** - IoT Enabled Monitoring and Control of Water Distribution Network. *Chinnusamy, S., Mohandoss, P., Paul, P., Rohit, R., Murali, N., Bhallamudi, S.M., Narasimhan, S., Narasimhan, S*. **101** - Field Testing of Adelaide CBD Smart Network Acoustic Technologies. *Stephens, M.L., Gong, J., Marchi, A., Dix, L., Lambert, M.F*.

TECHNICAL SESSIONS WEDNESDAY 09:30 – 11:00

BioSci 1102 *Resilience & Reliability*	**W11: Resilience and Reliability of WDSs** Session Chair: *Stefano Alvisi*
	198 - Integrating Graph Theory and Hydraulic Model-Based Measures for the Analysis of WDN Resilience. *Ulusoy, A., Stoianov, I., Chazerain, A*. **216** - Mechanistic Framework for Analyzing Cast Iron Water Main Fractures. *Singh, P.R., Kanvinde, A., Narasimhan, S*. **221** - Post-Earthquake Resilience Assessment of Water Distribution Network. *Han, Z., Kou, X., Hou, B., Wu, S*. **172 -** Optimal Management Planning Model of Water Suspension Risk in Water Supply System. *Kim, T.H., Kim, K.B., Seo, J.W., Hyung, J.S., Kim, D.I., Koo, J.Y.*
BioSci 1103 *WDS Modelling*	**W12: Water Distribution Network Modelling** Session Chair: *Tom Walski*
	145 - Extending the Capabilities of EPANET User Interface with the Optimal Design Plugin Tool. *Kandjani, E.M., Sela, L., Faust, K., Leite, F., Hodges, B.R*. **163** - Pressure Dependency of Total Demand in Water Distribution Networks. *Janus, T., Ulanicki, B*. **164** - Relation Between Population Density and Topology in Potable Water Distribution Networks. *Moreno, C., Rojas, D., Saldarriaga, J*. **173** - A Micro-Scale Analysis of Pressure Dependent Analysis: Impacts on Network Scale PDA. *Schück, S., Lansey, K.E*.
BioSci 1120 *Security of WDSs*	**W13: Security Against Threats to WDSs** Session Chair: *Avi Ostfeld*
	123 - Improving Contamination Detectability in Water Distribution Systems using Active Fault Detection. *Lifshitz, R., Ostfeld, A., Vrachimis, S.G., Eliades, D.G., Polycarpou, M.M*. **070** - Detection of Chemical Intrusion Compounds in Water Distribution Networks by Quality Sensors Data Mining. *Oliveira, E.C.M., Brentan, B.M., Dantas, R.F., Macedo, L.S., Junior, E.L., Ribeiro, L.C.L.J*. **071** - Multiobjective Optimization and Rule Extraction for Optimum Location of Quality Sensors in Water Distribution Network. *Cardoso, S.M., Barros, D.B., Oliveira, E.C.M., Brentan, B.M., Junior, E.L., Ribeiro, L.C.L.J*. **096** - A Clustered Minimum Volume Ellipsoid Model for Event Detection in Water Networks. *Naamnih, J., Ostfeld, A*.

TECHNICAL SESSIONS WEDNESDAY 09:30 – 11:00

Humphrey 102 *WDS Operation*	**W14: WDS Operation and Maintenance** Session Chair: *Peter Schaap*
	038 - Simplified Approach for Water Distribution Network Dividing. *Giudicianni, C., Nardo, A.D., Greco, R., Santonastaso, G.F*. **085** - Evaluation Diagnosis of Water Distribution Pipeline Utilizing Inspection Results of In-Pipe Endoscope Camera. *Kunizane, T., Koizumi, A., Arai, Y., Yamamoto, M*. **122** - Application of Inequity Indices for Water Supply Between District Metered Areas – A Case Study on Bangalore South Zone, India. *Kumar, K.R.S., Kumar, M.S.M., Bharadwaj, A., Sundaresan, R*. **188** - The Relevance of Enhanced Hydraulic Modelling for Asset Management and Related Performance Indicators. *Perrone, G., Palma, F., Laucelli, D., Berardi, L., Simone, A., Giustolisi, O*.
Humphrey 131 *Leakage*	**W15: Leakage Management, Detection and Modelling** Session Chair: *Angela Marchi*
	176 - Pressure-Driven Leak and Burst Diagnosis Under Demand Uncertainty in Water Distribution Networks. *Jahanpour, M., Tolson, B.A*. **191** - Characterizing Leakage in a Real Transmission Main by Means of a Pipe Condition Assessment Equipment. *Nsanzubuhoro, R., van Zyl, J*. **192** - Water Distribution System Leakage Control by DMA Management: A Case Study. *Hou, Y*. **205** - An Integrated Urban Water Management Scheme: From Source to Tap. *Kofinas, D., Laspidou, C*.

TECHNICAL SESSIONS WEDNESDAY 11:15 – 12:45

BioSci 1102 *Instruments & Sensors*	**W21: Advances in Instrumentation Technologies for Water Applications** Session Chair: *Michael Hulley*
	153 - Water Supply Flow Measurement Using Experimental Data and CFD Modeling. *Martim, A.L.S.S., Filho, L.S.C., Brentan, B.M., Filho, J.G.D*. **195** - In-Pipe Free-Swimming Device for Leak Detection in Water Distribution Pipe Based on SVM. *Tu, D., Yuan, S., Yu, J., Zhang, G., Zhang, H., Hou, D*. **199** - Advances in Development and Testing of a System of Autonomous Inspection Robots for Drinking Water Distribution Systems. *Thienen, P.v., Bergmans, B., Diemel, R., Helgers, M., Holzhaus, P., Horst, P., Trietsch, E., Vogelaar, H., Summeren, J.v., Waal, L.d., Hillebrand, B*. **113 -** Physical Modelling of an Hydropower Generation Station and Simulating Turbine Energy Losses. *Kuan, S., Li, J., Fok, A.*
BioSci 1103 *Big Data*	**W22: Big Data Techniques and Analysis** Session Chair: *Donghwi Jung*
	049 - Improving Time to Failure Predictions for Water Distribution Systems Using Extreme Gradient Boosting Algorithm. *Snider, B., McBean, E.A*. **124** - Characterizing Pressure Patterns in a Water Distribution Network Using a High-Frequency Monitoring System and Statistical Modeling. *Sela, L., Rasekh, A., Shafiee, M.E., Preis, A*. **128** - Sorting High Temporal Resolution End-Use Data – A Pleasurable Headache. *Ilemobade, A., Jacobs, H.E., Botha, B.E*. **072** - Comparing Deep Learning with Statistical Control Methods for Anomaly Detection. *Wu, Z. Y., He, Y., Li, Q.*
BioSci 1120 *Security of WDSs*	**W23: Security Against Threats to WDSs** Session Chair: *Fabian Papa*
	103 - Modeling Cyber-Physical Attacks on Water Networks with epanetCPA. *Taormina, R., Galelli, S., Douglas, H.C., Tippenhauer, N., Salomons, E., Ostfeld, A*. **137** - Water Distribution System Tools to Support Security and Resilience. *Haxton, T., Janke, R., Murray, R., Burkhardt, J., Grayman, W.M., Ernst, H.* **047** - Incorporation of Uncertainty in Contamination Source Identification. *Rahman, M., Intisar, A., Banik, B.K*.

TECHNICAL SESSIONS WEDNESDAY 11:15 – 12:45

Humphrey 102 *WDS Operation*	**W24: WDS Operation and Maintenance** Session Chair: *Bogumil Ulanicki*
	120 - Control of Pump Operation by Feedback Rules Derived from Optimal Time Schedules. *Damania, M., Ulanicki, B., Paluszczyszyn, D*. **186** - Automatic Approach to Design District Metered Areas for Water Distribution Systems. *Pesantez, J.E., Berglund, E.Z., Mahinthakumar, G*. **210** - A New Estimation Technique for Performance Curves of Variable Speed Pump Using a Scada Database. *Woo, H., Uber, J.G., Boccelli, D.L., Choi, D*. **016** - Practical Analysis of Cleaning Water Supply Pipeline Using Air and Water Flushing Technology. *Shui, S.Y*.
BioSci 1101 *BPDRR 2018*	**W25: Battle of Post-Disaster Response and Restoration** Session Chair: *Diego Paez*
	034 - After Earthquake Post-Disaster Response Using a Many-Objective Approach, a Greedy and Engineering Interventions. *Castro-Gama M.E., Quintiliani, C., Santopietro S*. **042** - A Heuristic Approach to Water Network Post-Disaster Response and Restoration. *Sweetapple, C., Meng, F., Farmani, R., Fu, G., Butler, D*. **087** - A Greedy Scheduling of Post-Disaster Response and Restoration using Pressure-Driven Models and Graph Segment Analysis. *Deuerlein, J., Gilbert, D., Abraham, E., Piller, O*. **104** - Battle of Post-Disaster Response and Restauration (BPDRR). *Zakrzewski, P., Brodziak, R., Bylka, J., Balut, A*. **117** - A Two-stage Post-Disaster Response and Restoration Method for the Water Distribution System. *Li, Y., Gao, J., Jian, C., Ou, C., Hu, S*. **118** - Simulation-Based Framework for the Restoration of Earthquake-Damaged Water Distribution Networks using a Genetic Algorithm. *Sophocleous, S., Nikoloudi, E., Mahmoud, H., Woodwa, K., Romano, M.* **162** - Post-Disaster Response and Restauration of B-Town Network Based on Prymary Network. *Santonastaso, G.F., Creaco, E., Di Nardo, A., Di Natale, M.* **169** - Near-Optimal Restoration Scheduling of Damaged Drinking Water Distribution Systems using Machine Learning. *Bibok, A.* **215** - Determination of the Hydraulic Restoration Capacity of B-City Involving a Multi-criteria Decision Support Model. *Salcedo, C., Aguilar, A., Cuero, P., González, S., Muñoz, S., Pérez, J., Posada, A., Robles, J., Vargas, K.* **054** - Solving the battle of post-disaster response and restauration (BPDRR) problem with the aid of multi-phase optimization framework. *Zhang, Q., Zheng, F., Diao, K., Ulanicki, B., Huang, Y.*