

# Software for Drinking Water & Wastewater System Reliability: Evaluation, Optimization, and Effluent Quality Risk OTT ID #1491/1531

Municipal water/wastewater systems are critical infrastructures in our modern society. The reliable, secure and economical treatment and distribution of water is essential to supporting human life and national economic growth. Many cities are currently faced with deteriorating water distribution infrastructures which regularly cause water main breaks and service interruptions as well as the failing wastewater treatment facilities which may lead to effluent quality risk. The reliability of water/wastewater systems is critically important, as the loss of water supply or the discharge of untreated wastewater will bring serious health, economic, environmental, and legal consequences.

Improving the existing water/wastewater infrastructure is high on the agenda as stakeholders look to build more reliable and more efficient water/wastewater systems. Our holistic reliability analysis of these systems considers a comprehensive set of probable or contingency scenarios.

## TECHNOLOGY



Our software and proprietary algorithms aim to develop comprehensive decision support tools for evaluating the reliability of municipal water/wastewater systems, enabling cost-effective preventative measures *before* system failures.

system With our solution, water planners and operators can make informed decisions on resource allocation for reinforcing the water infrastructure; and asset management strategy can be optimized to enable effective water/wastewater utilitv infrastructure management despite ever evolving water sector uncertainties.

#### FEATURES/BENEFITS

- System reliability analysis and comprehensive decision support tool
- Implement cost-effective preventative measures before system failure
- Informed decisions on resource allocation (e.g., budget allocation and staffing projection)
- Optimized asset management strategy for water/wastewater systems

#### **APPLICATIONS – PRESENT & FUTURE**

- Drinking water distribution systems of various scales
- Water & wastewater treatment plants of various scales



## INTELLECTUAL PROPERTY

Copyrighted Software. See screen shots below for current user interfaces.

						- <b>K</b>	Statistic States and an array	and the state of the	And a read			-
Probabilistic Reliability Evaluation of Water Distribution Networks are being howers for twee streng for Reli		10 10 10 10 10 10 10 10 10 10 10 10 10 1	wargaaca afikkona Carlo Alian soo atoo atoo atoo atoo Maraban Nusta	Sinulator	Francowtises of	Per valence for lan lay frankrise an Lonar Jammer Lander Status Lander Status Reservations 2 Per visit a sector frankrise Server and strategy and product Server and strategy and p. 1.	a Veen Couliny field of Some with some West offen some Some of M	Anternet al Viela de las Anternet al Viela de las VI das de las las antes desse antes desse an Constituir de la Antes de la Antes de la Antes de la constituir de la constituir de la Antes de la constituir de l	n Toolman Anno ar Gray Salam 14 anno 2014 Anno ar anno 2016 ar anno 2016 Anno 2016 Anno 2016 Anno 2016 Anno 2016 Anno 2016	Country Later A rankly table	wep	
elitekte faransken file faste CV/RNRT, Sectorian, J. Soleitik (d. 1997)		nelalite Solucion Realta Relatio Solucion d'Aveal Sateri Relatio Solom af Boolersia -			Tel Pie secony Dreet Bale	=	Casesquere or record	Cercumento	8111			
SIRVET, Tersiver, J. Dennet bt			Receiving of their	rided Water Denaids	Percentage of counted water (moved)				54			
Nation Lipitone		Productionary of Local of Waters Reverses		Recoal Ro ef Less of Welsh Services		40 A		°		1 . W		
Telephone PCI Telephone PCI	Sinuana: Conpeted		Benched Water Het Sacoliet Office Galore) 8.745302		Depicted Water Not Bygchid (Miller-galeric) 0.004680		Town the second	<u> </u>	A STOR STOR I	m (m (m)		the moder from the
HCS SITURDER HOW IS	1008		Density of Water 1	lantani Coropinanto	· · · · · · · · · · · · · · · · · · ·		Rentin Autoriti Telanti Golde (2015) File alle Renetas d'Atorisi Palanan (2014)		6-12.10	Parallel of Parals	Prevalence of the same of same size forms in the ACA Principles of the same of these former of a ACA	
Internet Critically Settings Social Distorm Economic Critical Order of Contingencies	42 Pr: Analyse 2	itart Simulation	Conjecture & Conjecture Type 2100 1995 4100 2005 4120 2005 4120 4100 4120 4100 4100 4100 4100 4100 4100 4100 4100 4100		Usiva25879 8.003299 8.002521 8.002539 8.002219 8.002219 8.002219	0.65%3 ************************************	Novel passe of Maximum Instead of Operation Section (in: mean Development Instanty of Analysis Appendix and In-	(Moletti, Onlin admittant) (on Dama)	180407 130876 144.872	Products of the an- matches of the sec- biner Probably of the Products of Control	and more Posts of Part Bank and NT David Jack Too Good Tool date Too	anen 17919 Ierte Mitte Erre Kinnen I
			14			10.8.0	ar-dependent and	-	-		01110	ree bi

### MARKET

The software is intended to add value to water utilities through cost savings, including preventive maintenance and guiding resource allocation. Assuming preventive maintenance costs are less than catastrophic damage repair costs, the total opportunity based on the annual repair cost of broken water mains is approximately \$3 billion.

The U.S. Environmental Protection Agency recently began collecting information for its second Drinking Water Infrastructure Needs Survey [and] found that <u>municipalities expected to spend some \$77.2</u> <u>billion over the next 20 years</u> to satisfy that need. In a similar survey conducted on the wastewater side of the industry, the Clean Water Needs Survey found that <u>over the next 20 years cities need to spend</u> <u>\$10 billion on upgrading existing wastewater collection systems</u>, nearly \$22 billion for new sewer construction and \$45 billion for controlling combined sewer overflows. Another \$7 billion is needed to control municipal storm water.

#### AUTHOR

Dr. Lingfeng Wang is an Associate Professor in the Department of Electrical Engineering and Computer Science at the University of Wisconsin-Milwaukee, where he directs the Trustworthy Cyber-Physical Systems and Infrastructures Laboratory. Dr. Wang's research is focused on the quantitative risk assessment for national critical infrastructures from the perspectives of system reliability, resiliency and cybersecurity, including electrical energy systems, drinking water distribution systems, wastewater reclamation facilities, natural gas distribution networks, smart cities, etc. His research team is also working to build comprehensive, stochastic models for capturing the interdependencies among critical infrastructures (e.g., water-energy nexus) in order to improve their resiliency in the presence of natural or man-made disasters. He is the author or co-author of more than 300 technical publications in these research fields.

For further information please contact: Jessica Silvaggi, Ph.D. Senior Licensing Manager UWM Research Foundation Email: Jessica@uwmrf.org Tel: 414-906-4654 Please reference: OTT ID. 1491/1531