SOLUTIONS FLOW NATURALLY AT U of T

U of T Engineering has a proven track record of helping water industry professionals meet their needs while saving money and reducing their impact on the environment. We can deliver the same value to your industry. Whether you are in consulting engineering, project management, new technology development or municipal planning, our experts can deliver solutions to help you succeed.

HERE'S WHAT PARTNERING WITH U OF T ENGINEERING DELIVERS:

- An inside track to breakthrough technologies
- Customized solutions to industrially relevant problems
- An extra spark of innovation to your company
- Collaboration with U of T Engineering's world-leading researchers, including top graduate students, undergraduate students and alumni

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OFFICE OF THE VICE-DEAN, RESEARCH
FACULTY OF APPLIED SCIENCE & ENGINEERING
UNIVERSITY OF TORONTO

416-946-3038 | vdr@ecf.utoronto.ca
uoft.me/collaboration

RESEARCH IN FOCUS:

WATER TECHNOLOGY

CHALLENGE:

How can we better manage and provide water safely and efficiently?

SOLUTION:

Forward-thinking water technologies and informed decision making.

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THE POWER OF PARTNERSHIP

Clean water is critical for all human activities: drinking, agriculture, industry, recreation and more. While Canada enjoys abundant freshwater resources, it has a responsibility to use these reserves efficiently. New technologies that reduce both the financial cost and environmental footprint of treatment — while maintaining water quality — are attractive not only in Canada, but around the world.

University of Toronto civil engineering professors Robert Andrews and Ron Hofmann share an NSERC Industrial Research Chair in Advanced/Emerging Technologies for Drinking Water Treatment. This unique collaboration involves the City of Toronto, Region of Peel, Region of Durham and other major providers of drinking water to the five million residents of the Greater Toronto Area. It also includes industry partners like General Electric Water & Process Technologies.

Andrews, Hofmann and several other U of T Engineering researchers will join a new collaborative hub called the Institute for Water Innovation (IWI), which will focus on water sustainability, treatment and management. IWI is one of the many cross-disciplinary research institutes that will reside in the forthcoming Centre for Engineering Innovation & Entrepreneurship, slated to open in 2017. Through the support of donors and industry leaders around the world, IWI will help position U of T Engineering as a leader in global water innovation.

THE DETAILS

"We work closely with the water treatment industry to understand what problems they have to solve today, and the emerging pollutants they'll have to deal with in the future. Those challenges and trends are what drive our research program."

PROFESSOR ROBERT ANDREWS
NSERC Industrial Research Chair in Source Water Quality Monitoring and Advanced/Emerging Technologies for Drinking Water Treatment

An emerging problem with drinking water is the presence of trace amounts of pharmaceutical compounds — many of the drugs we take pass through our bodies, into wastewater, and eventually into the lakes and rivers we rely on.

Andrews and Hofmann study a technology called advanced oxidation, which involves blasting the water with everything from ultraviolet light to ozone and hydrogen peroxide. This quickly and reliably breaks down any chemical compounds that may be in the water.

Another innovation involves fortifying upstream filters, which are typically made of a granular substance like sand. Like soil, these filters often develop biofilms, communities of algae and other microorganisms that consume contaminants and reduce the load on downstream processes. "In the summer it works well but not in the winter," says Andrews. "We're looking at adding additional nutrients like nitrogen and phosphorus to encourage biological growth, and save energy and money." Mimicking nature to remove contaminants upstream reduces strain on downstream processes, saving energy and money.

Water research at U of T also addresses the critical challenge of water and sanitation. Most improved sanitation systems, such as sewerage systems or ventilated pit latrines, require centralized processing that exposes populations to leaks, spills, illegal dumping, and grave health risks. A team led by chemical engineering professor and director of the Centre for Global Engineering, Yu-Ling Cheng, is developing a waterless sanitation appliance that rapidly disinfects waste on-site, reducing the threat of exposure.

PROFESSORS BRENT SLEEP AND ELIZABETH EDWARDS
RESTORING CONTAMINATED GROUNDWATER

Across Canada, past industrial activity — from mining to industrial chemical production — has left behind over 22,000 sites with contaminated soil and/or groundwater. A group of geologists and engineers led by U of T civil engineering professor Brent Sleep is ready to provide solutions through a project called Innovative Technologies for Groundwater Remediation (INTEGRATE). The initiative includes investigators from three Ontario universities as well industrial partners, such as Dow Chemical Canada ULC, and engineering consulting companies CH2MHill, Pinchin Environmental and Geosyntec Consultants.

Contaminants can be degraded by bacteria that use them as a source of energy, but this process can be slow. The INTEGRATE team is looking at ways to accelerate this process. Approaches include adding nutrients to help the bugs grow faster, pre-treating the soil with potassium permanganate or iron nanoparticles to give the bacteria a head start on the degradation, and inserting custom communities of bacteria that are more efficient at breaking down contaminants. In particular, chemical engineering professor Elizabeth Edwards has isolated and maintained a community of microbes called KB-1 that is particularly good at degrading chlorinated compounds and is distributed through her spinoff company, SiREM.

Professor Elizabeth Edwards works with students at U of T Engineering's BioZone. She holds the Canada Research Chair in Anaerobic Biotechnology and serves as BioZone's director.

PROFESSOR BRYAN KARNEY
MODELLING FLUID FLOW

When you quickly turn off a tap, a moving column of water slams to a halt, creating a shock wave that travels backward along the pipe. In small pipes this wave usually is not big enough to cause anything more than a 'hammering' sound, but in a larger pipe, the effect can create pressure waves big enough to damage or even destroy pipes, pumps and other infrastructure.

Environmental engineering and energy systems expert Professor Bryan Karney and his team build mathematical models to analyze the impacts of this 'water hammer' effect across complex systems and to determine where additional reinforcement or buffering systems that absorb extra energy are needed. Karney's spinoff company, HydraTek and Associates Inc., has been in business more than two decades and has helped design everything from water supply systems in Mozambique to a new jet fuel distribution system for Pearson International Airport.

His company also created technology that can be used to gauge the efficiency of pumps and determine which ones should be maintained or replaced to save on energy costs. A recent project funded by the Ontario Power Authority Conservation Fund tested hundreds of pumps across the province; it found that by replacing certain pumps, municipalities could save almost $2 million in energy costs per year.

PROFESSOR JENNIFER DRAKE
GOING WITH THE FLOW

Our buildings and roadways are designed to get rid of water as quickly as possible, in sharp contrast to the slow filtration through soil that is typical of natural systems. Combined with rising storm intensity resulting from climate change, the stage is set for catastrophic flooding such as that recently seen in Toronto and Alberta. The estimated cost of the flood in Toronto is $850 million in insurance claims and $60 million in repairs. In Alberta, the approximate cost exceeds $5 billion, and in terms of insurable damages, is the costliest disaster in Canadian history at $1.7 billion.

Civil engineering professor Jennifer Drake aims to restore natural flow systems through technologies like water-permeable pavements, which allow for groundwater recharge and restoration of river-like flows.

Cross-appointed to the Green Roof Innovation Testing Laboratory (gritlab) in the John H. Daniels Faculty of Architecture, Landscape & Design, Drake also helps optimize the design and cost-effectiveness of green roofs which, among other things, can reduce peak stormwater flows. Her analysis helps designers work around the challenges of retrofitting older buildings, as well as track the impact of green roofs on the city and its infrastructure.