

An illustration at the top of the page shows a person in a blue shirt and red pants sitting in a white boat. A large red buoy is visible on the left side of the boat. The background is a teal color with white bubbles or droplets scattered throughout.

Clean water

• BY ANDREA GUNN

• What would it take to make clean, potable water available to everyone? Who should be involved in assessing the long-term damage of an oil spill in a river? What don't we yet know about effects of contaminants in our drinking water?

• And where do the big issues in water research best fit? In Civil Engineering? Chemistry? Epidemiology? Environmental Studies?

• Yes.

All of the above, and more. That's where the Beaty Water Research Centre comes in.



In 2010, the original Water Research Group evolved from the desire for increased collaboration among researchers and students from both Queen's and RMC. Geof Hall, an adjunct professor in both Civil Engineering and Environmental Studies recalls, "During discussions with other faculty members, we realized there were common research interests. We all thought, 'Why don't we collaborate and build something bigger?' And it snowballed from there. We have had groups come together from Biology and Engineering to develop large research grant proposals addressing some really big questions."

One of those big questions discussed was related to the effects of oil spills in freshwater systems. Ana da Silva leads a project that examines the issue. "We know a lot about oil spills in oceans, but very little about oil spills in rivers," she says. "It's a very confined environment." With the potential of oil pipelines crossing rivers across Canada, Queen's researchers wanted to take an objective look at the possible outcomes of an oil spill. With Kevin Mumford (Civil Engineering), Stephen Brown (Chemistry, Environmental Studies), Peter Hodson (Environmental Studies), and Allison Rutter (Analytical Services Unit), Dr. da Silva received an NSERC Strategic Project grant to study the problem. The multidisciplinary team and their graduate students address the issue from different viewpoints, using facilities at the Queen's Coastal Engineering Lab and in the Department of Biology. "Our goal is to assess, if there is an oil spill in a river, what is the kind of damage that can occur, especially to fish species like trout and salmon, which deposit their eggs on the river bottom."

"With this type of project," says Dr. da Silva, "we can give students a broader perspective, and prepare them to deal with these types of problems in the work world, whether they go on to work in industry or government or academia."

A critical mass

The Water Research Group was formalized, in 2012, into the Water Research Centre, an interdisciplinary centre dedicated to furthering research on water governance and sustainability and the protection of water resources, among other topics. It had 22 core faculty members, representing the Queen's departments of Civil Engineering, Chemical Engineering, Geography and Planning, Environmental Studies, Biomedical and Molecular Studies, Chemistry, and Biology, and departments at Royal Military College.

In 2017, Queen's University received a \$5-million donation from Ross J. Beaty to support collaborative research and education around freshwater resources. "Interdisciplinary teams such as the water research centre at Queen's are the way of the future," said Mr. Beaty at the time of the gift announcement. "I hope that through my gift, these collaborative activities will grow and thrive, providing researchers with the support they need to give our future generations a world they deserve."

With the opening of the Beaty Water Research Centre this spring in the Innovation and Wellness Centre, the possibilities of research collaboration will expand exponentially. The brand-new 10,000 square-foot laboratory space is a big change from the small space they leave behind in Ellis Hall. The laboratory will be designated a biohazard level 2 facility, featuring environmental chambers, walk-in fume hoods, meta-genomics tools, and other equipment to get things started. Additional instrumentation will be added as people come together on new

projects, identify the resources they need, and secure funding for collaborative projects.

"This will be a facility with the critical mass of people, instrumentation, and research space needed for cutting-edge water research," says Pascale Champagne,

the Canada Research Chair in Bioresources Engineering and the centre's director. The facility will be the regional hub for water research while still connecting students and faculty to water facilities elsewhere. Faculty members from Queen's and RMC who have their own labs off-site, as well as industry partners and researchers from other institutions, will also be able to access the facility and its resources.

Collision space

Just as important as the expanded laboratory space in the new facility is what is called "collision space" – rooms for researchers, students, visiting scholars, and industry partners from different disciplines to brainstorm together and come up with new solutions to water problems. "Some of the most creative collaborations have evolved, in my experience," says Dr. Champagne, "through these types of informal discussions. The exchange of ideas over lunch or in the laboratory can lead to 'Eureka' moments and new ways to tackle a problem. It's important to have this space, where the research is actually happening, where ideas can ferment and evolve."

"The support they need to give our future generations a world they deserve."

The illustration features a large, stylized water drop in the center, with a person standing on a ladder and looking into it. The background is a deep blue with several smaller, lighter blue water drops floating around. The overall theme is water research and exploration.

The purpose of the Beatty Water Research Centre is to foster an environment that encourages collaborative research spanning traditional water-related disciplines as well as non-traditional and emerging disciplines.

Through its key pillars of **research**, **education**, and **outreach**, the centre will foster and support activities in water **governance**, water **use**, water **resources**, and water **quality**.

Emerging issues

With their combined expertise, the members of the Beaty Water Research Centre are perfectly situated to address growing issues in clean water in a variety of ways. For Geof Hall, the manager of the centre, one of the most interesting is a class of contaminants referred to as “emerging compounds of concern.”

“This includes pharmaceuticals that get flushed down the toilet,” he says, “both from people discarding their pills and from the metabolites that pass through the body. It all goes into receiving environments – lakes, rivers, groundwater – where it accumulates, and then we drink it. Some of these compounds are found in shampoo, toothpaste, and artificial sweeteners. Some are easily broken down in water; others are very resistant.”

“We need to support further research into optimal treatment methods and technologies, along with understanding the long-term effects of exposure to these accumulated compounds in the receiving environments. What does that do over a lifetime? Maybe this is something that will never be known, but those are the kinds of questions that are emerging.”

So how best to tackle this issue?

Some of the compounds may turn out to be harmless, but this first needs to be established. Understanding the long-term effects of minute levels of these compounds on human health brings in microbiology and epidemiology. If it is determined that the compounds need to be removed from the water, this can be addressed in a number of ways, starting with wastewater treatment. “From the engineering side,” says Dr. Hall, “we can examine whether conventional treatment could work. Are there technologies that can be added to a conventional wastewater treatment plant? Or, from a biology perspective, you may want to treat the water naturally, through a constructed wetland. Then you would need to understand what it’s doing to the aquatic ecosystems, so *that* brings in environmental studies and toxicology.”

“If the emerging contaminants of concern can’t be dealt with on the wastewater treatment side, then research on the removal of these contaminants from drinking water needs to be pursued. Is there a way to treat potable water to remove the compounds before people consume it? That all involves engineering, biology, and health sciences.”

Collaboration as knowledge transfer

The collaborations are not just happening among faculty members. New ideas are always being developed to leverage the work done at the centre and take it to new audiences. In Civil Engineering, for instance, Kevin Mumford is partnering with Art the Science, a not-for-profit organization. Art the Science is facilitating an artist residency this March in Dr. Mumford’s lab that presents environmental engineering research in a new visual medium. An artist will work alongside students on a project investigating, among other issues, contaminants in soil and groundwater. “Collaborations like this are important,” says Dr. Mumford, “because the results of science and engineering need to be communicated. It’s exciting to think about that communication happening over multiple channels, not just through journal articles and conferences, but through art.”

Outreach is a critical component of the centre’s mandate. “It is important,” says Dr. Champagne, “that research and knowledge, no matter how leading-edge, is relevant and transferable to society.” Outreach activities often include both

graduate students and faculty members connecting with the Kingston area community. The Great Lake Water Festival, held every summer at Lake Ontario Park, teaches grade four students about water conservation and stewardship. The Engineer-

ing Summer Academy (through the Faculty of Engineering and Applied Science) immerses high school students in water-related, environmental engineering field activities. For the general public, the centre is planning a speaker series on water research, utilizing the expertise of its own faculty as well as visiting scholars.

Connecting future leaders

The 2013 Water Symposium brought together graduate students at Queen’s and RMC to discuss their research. This grew, the following year, into the first WATIF (Water Initiative for the Future) conference, created by graduate students for their peers. The conference builds communication and collaboration among peers across a variety of disciplines, building the potential for future partnerships as they move forward in their careers. First offered as a national conference in 2014, it attracted international attendance in 2016. The third WATIF interdisciplinary conference will be held at Queen’s later this year.

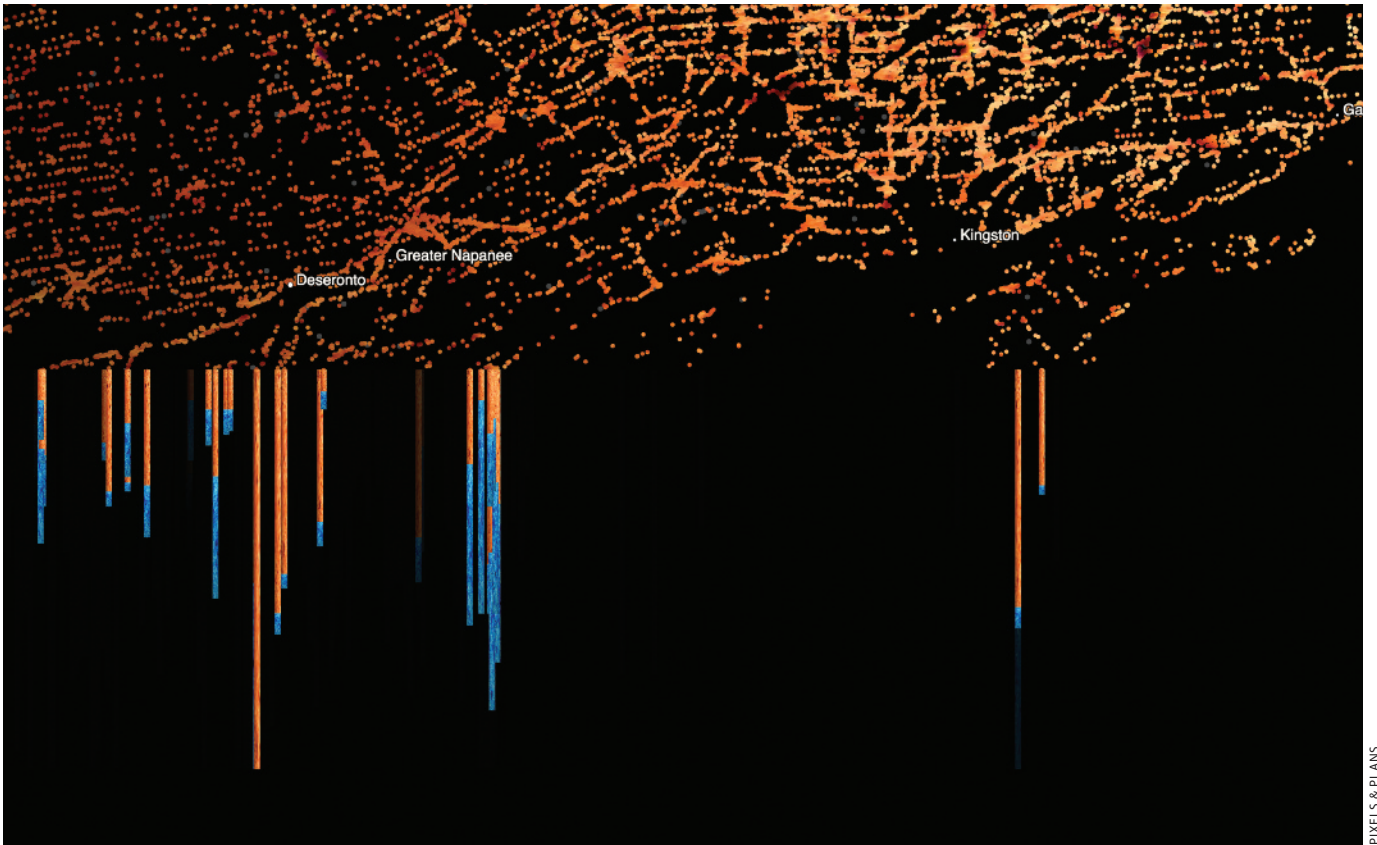
“It is important that research and knowledge is relevant and transferable to society.”

New educational opportunities

New formal programs are also in the works. The first is a Water and Human Health graduate diploma, an online program designed to give recent graduates and professionals enhanced training on the impacts of water on health. “We have a number of students who want to go on to work in development agencies,” says Dr. Hall. “Others will be pursuing careers in environmental and

engineering consulting and would benefit from a greater knowledge of human-water interactions.”

So, as well as connecting people from different faculties and with different skill sets, the centre’s programs encourage a cross-disciplinary approach for individual students. “We’re seeing students who can look across the boundaries of traditional disciplines in search of new ways to solve problems. Quite frankly, that’s the future.” ■



Depth to Water

Depth to Water is a code-based artwork that uses 367,089 private well water data points to map the geography of Ontario. It also displays the depth at which water was found for each well at a 100-meter scale, revealing a slice-view of the aquifer. Above, a section of the artwork shows the wells in the Kingston-Napanee region.

Artists' statement

Thousands of points form recognizable territories, thereby connecting the viewer to familiar places. As regions pass across the screen, each dot transforms into a single unearthing of water. *Depth to Water* places emphasis on groundwater as one continuous subterranean resource, no longer assigned to a temporal scale and summed up by a myriad of water discoveries. While most residents rely on municipal water sources (as evidenced by a lack of data points near larger cities), a sub-set depend on groundwater wells. When wells are depicted as a perforated sheet transitioning over a watercolour canvas, the extent and scope of our groundwater use is revealed. As Benjamin Franklin said: “When the well is dry, we know the worth of water.”

Julia Krolik, MSc'14 (Pathology), and Owen Fernley, Sc'01 (Geological Engineering) of Pixels & Plans created *Depth to Water* for the 17th Canadian National Conference on Drinking Water. The work is currently exhibited in several places, including Art the Science's Polyfield Gallery. You can view the full work at artthescience.com/polyfield-gallery/depth-to-water.