

the water institute

ANNUAL REPORT 2015/2016



UNIVERSITY OF
WATERLOO



our vision

To be a global leader that substantially advances the sustainable use and management of water for the benefit of the environment, economy and society

our mission

To facilitate collaboration, support excellence and promote innovation in interdisciplinary research and education, and to promote knowledge exchange in addressing complex water challenges

strategic goals

1. Promote and support relevant, collaborative, interdisciplinary water research
2. Strengthen global networks and partnerships with leading water organizations and researchers
3. Promote interdisciplinary perspectives in water-related education
4. Strengthen the capacity of water resources professionals



MESSAGE FROM THE CHAIR OF THE EXTERNAL ADVISORY BOARD

The purpose of the Water Institute's External Advisory Board is to provide an independent perspective on progress towards Institute goals, and to offer recommendations on how it might make a greater impact. The Board — comprised of representatives from the public sector, the private sector, civil society and academia — takes its role very seriously, and endeavours to provide substantive and practical advice on how the Institute can fulfill its potential.

Since the Board's first review, in 2012/13, the Institute has made much progress. Over the past three years, we have been particularly impressed by its graduate students section (SWIGS), *WaterTalks* lecture series, annual Research Symposium, External Partners Program, Seed Grant Program, and the formation of the graduate Collaborative Water Program. In its 2014/15 report, the Board noted, with anticipation, that 2015/16 would be an exciting year, and a year that would be "all about taking the Water Institute to the next level."

I am very excited that the University has recruited Roy Brouwer, an eminent water economist, as the Institute's new executive director. I have had the pleasure of meeting Roy on several occasions, and we have discussed important progress against key Institute priorities, such as an improved governance structure, the implementation of a communications strategy, and the operationalization of a research agenda. Under his leadership, I am more confident than ever that the Institute is poised to fulfil its potential, to reach the "next level," and to, most importantly, make a lasting positive impact on the health of our water resources. 🌊



TONY MAAS

*Director, Forum for Leadership on Water (FLOW)
Manager of Strategy, Freshwater Future*

MESSAGE FROM THE EXECUTIVE DIRECTOR

Beginning as the Water Institute's new executive director in January 2016, I was aware there was something truly unique about the "water" in "Waterloo." A commissioned international benchmark study has since helped to validate this, revealing our position as the most multidisciplinary water research institute in Canada.

Looking back, it was a landmark year in terms of growing our capacity to act as an international water think tank. We emphasized the role the social sciences play in expanding our collective knowledge on global water issues. We also welcomed over 600 attendees to our public lectures and brought new knowledge and perspectives to our campus community via four carefully selected RBC Visiting Fellows. In addition, interest in our Seed Grants Program grew; after receiving our highest number of applications, eight grants, totaling \$150,000, were awarded to exceptional interdisciplinary teams. We also saw the highest enrolment to-date in our graduate Collaborative Water Program and provided access to a number of scholarships for water students.

Planning has been underway to bring Elsevier's 4th Water Research Conference to Waterloo in September 2017 — an important step in increasing our international profile. The theme: "The Role of Water Technology Innovation in the Blue Economy" reinforces our leadership in inter- and transdisciplinary research and education, linking water science and engineering to water economics and governance.

In the coming years — together with our members, students and stakeholders — we will strive to grow Waterloo's water research profile. We aim to create new alliances and opportunities for all, rising to new heights of excellence in water research and education. 🌊



DR. ROY BROUWER

Executive Director, the Water Institute



what we do

The University of Waterloo established the Water Institute in 2009, building on four decades of excellence in water research, education and innovation. We have more than 150 faculty and 400 graduate students from across all six faculties (Applied Health Sciences, Arts, Engineering, Environment, Mathematics and Science) and 19 departments.

Waterloo's water research is diverse, and collectively comprehensive, with core disciplinary expertise in the following areas:

- » hydrological science and engineering
- » water and wastewater treatment
- » ecohydrology
- » aquatic ecology and ecotoxicology
- » water governance and management
- » water and health
- » water economics

One of our primary objectives is to facilitate interdisciplinary research and education to address increasingly complex water issues.

We provide members with a range of services, including:

RESEARCH

- » securing funding opportunities
- » connecting researchers who share common interests
- » establishing and supporting researcher working groups and clusters
- » soliciting letters of support for research projects
- » reviewing and advising on research proposals
- » providing in-kind support for research projects


EDUCATION

- » co-ordinating and supporting the graduate Collaborative Water Program
- » administering graduate student scholarships
- » supporting the Students of the Water Institute, Graduate Section (SWIGS)


PARTNERSHIPS

- » cultivating industrial, governmental, civil society and other partnerships
- » hosting academic delegations at Waterloo
- » organizing faculty delegations to other countries
- » facilitating and supporting international collaborations
- » serving as a central point of contact

KNOWLEDGE EXCHANGE

- » supporting and organizing
 - workshops
 - research symposia
 - *WaterTalks* lecture series
 - distinguished lectures
- » publishing the triannual *SplashPad* newsletter
- » promoting researchers through various communications activities
- » facilitating and supporting media relations 

by the numbers

150 
FACULTY MEMBERS
6 FACULTIES
19 DEPARTMENTS

6 FELLOWS
OF THE ROYAL SOCIETY
OF CANADA

“ INSTITUTE MEMBER PAPERS WERE CITED
22,000
TIMES BETWEEN 2004 AND 2014

OVER
\$130 million
IN TOTAL SPONSORED WATER-RELATED
RESEARCH FUNDING
FROM 2009/10 TO 2014/15

 1 CANADA EXCELLENCE RESEARCH CHAIR
19 RESEARCH CHAIRS



STUDENTS OF THE
WATER INSTITUTE
GRADUATE SECTION
(SWIGS) HAS OVER

400
MEMBERS

INSTITUTE MEMBERS PUBLISHED OVER
1,900 PAPERS 
BETWEEN
2004 AND 2014

OVER
400
EXTERNAL PARTNERS 

the most
MULTIDISCIPLINARY
WATER RESEARCH INSTITUTE IN CANADA

10th BEST WATER RESEARCH
INSTITUTION IN THE WORLD

SOURCE: Lux Research Inc., Top Academics and Institutions in Water Research 2013.



20th MOST PROLIFIC RESEARCH
INSTITUTE IN THE WORLD

SOURCE: Stockholm International Water Institute and Elsevier, The Water and Food Nexus: Trends and Development of the Research Landscape, August 2012.

A landscape photograph of a field at sunset. The sun is low on the horizon, casting a warm glow over the scene. The foreground features a stream with lily pads, and the middle ground is a lush green field. The background shows a line of trees and a fence.

research

The promotion of relevant, impactful, collaborative, interdisciplinary research is our core mission.

RESEARCHERS IN THE NEWS

There is a great diversity and depth of research being undertaken by our faculty members, which makes summarizing 2015/16 activities challenging. Instead, this year we highlight projects that have deservedly received much public attention. The diverse projects present a snapshot of the quality, impactful activities being conducted by our researchers and their students.

Topsoil, as well as farm fertilizers and other potential pollutants, run off unprotected farm fields when heavy rains occur.

FERTILIZER APPLIED TO FIELDS TODAY WILL POLLUTE WATER FOR DECADES

Featuring Nandita Basu, Earth and Environmental Sciences/Civil and Environmental Engineering

It is well known that nitrogen fertilizer applied to farmers' fields can leach into drinking water wells, and can also contaminate rivers and lakes. In 2015/16, Water Institute member Nandita Basu and doctoral student Kim Van Meter published a new study that shows the first direct evidence of a large-scale nitrogen legacy across the United States' Mississippi River basin.

"A large portion of the nitrogen applied as fertilizer has remained unaccounted for the last several decades," said Basu, a professor jointly appointed to the departments of Earth and Environmental Sciences and Civil and Environmental Engineering. "The fact that nitrogen is being stored in the soil means it can still be a source of elevated nitrate levels long after fertilizers are no longer being applied."


Similar to phosphorus, nitrogen is a nutrient for plants and when applied as fertilizer helps increase crop yields. But to maximize these yields, an excess of fertilizer is often added, leaving large amounts of nitrogen in the soil. This nitrogen is easily converted to nitrate, a highly soluble, inorganic compound that has become the most common drinking water pollutant in the U.S. Since the 1970s, farmers and policymakers alike have worked hard to reduce the amount of fertilizer leaching from agricultural fields to groundwater and to nearby lakes and streams. Yet in some rural areas, nitrate levels in groundwater have been found to be more than 10 times the drinking water standard.

"Public drinking water sources are vulnerable to receiving elevated nitrate, but an even greater danger is for people in rural areas living on private well sources." said Basu.

To quantify the true extent of the nitrogen problem, numerous researchers have attempted to account for all of the nitrogen inputs to and outputs from watersheds around the world. These mass balance studies, however, have consistently come up short. Although we know that nitrate levels have been increasing in our waterways, the fate of much of the nitrogen that is applied to the land as fertilizer has remained a mystery.

Many scientists have suggested that this "missing nitrogen" must leave watersheds via denitrification, a reaction facilitated by microorganisms that transforms nitrate into the harmless nitrogen gas. Basu, however, saw evidence that nitrogen legacies could be present within the landscape. In analyzing long-term data from over 2,000 soil samples throughout the Mississippi River basin, they found a systematic accumulation of nitrogen in agricultural soils. In many areas, this accumulation was not apparent in the upper 25 centimeters plough layer, whereas, from 25 to 100 centimetres beneath the soil surface they found significant accumulation, accounting for as much as 50 per cent of net nitrogen inputs. Their modeling results suggest that this nitrogen legacy could still be leaching into waterways more than three decades after the nitrogen is no longer being applied to fields.

"The presence of this legacy nitrogen means it will take even longer for best management practices to have a measurable benefit," said Basu. "If we're going to set policy goals, it's critical we quantify nitrogen legacies and time lags in human impacted landscapes."

Basu and other Water Institute researchers are currently exploring nitrogen legacies in the Grand River watershed in southern Ontario, as well as across North America and at a global scale. 



Monica Emelko conducts a watershed assessment, in an unburned "reference" location, during the Fort McMurray wildfire.

WAS FORT MCMURRAY'S WATER SUPPLY CONTAMINATED BY THE WILDFIRE?

Featuring Monica Emelko, Civil and Environmental Engineering

As residents try to resume their lives following the ferocious May 2016 wildfire that forced the evacuation of Fort McMurray, crucial questions about its impact on their water supply still have no clear answers. It's why Water Institute faculty member Monica Emelko visited the devastated Alberta city shortly after the fire after spending countless hours on the phone with government officials as the crisis escalated.

“Our research has very real implications for communities, so as long as we're able to provide actionable science for decision-making, we'll continue to help,” says the Waterloo Civil and Environmental Engineering professor.

Emelko and colleagues at the Southern Rockies Watershed Project are uniquely qualified to tackle complex issues in Fort McMurray after studying the impact of wildfire on water supplies for more than a decade. The initial source of high-quality drinking water for almost six in 10 cities in Canada with populations over 100,000, healthy forests act as sophisticated natural purification systems. When rain falls on forests turned into bleak, grey-black landscapes by fire, however, ash and other contaminants are washed into rivers, potentially creating enormous challenges for municipal water treatment plants located downstream.

“Wildfire is a significant global problem that can be catastrophic for drinking water supply and treatment.” says Emelko. “It is exacerbated by climate change, which creates drier, hotter, and windier conditions that lead to more severe wildfires”

The obvious problem for treatment plants, contaminated water flowing into their intakes, is greatly aggravated by extreme variability of water quality, a function of when it rains and for how long.

“Rapid or extreme changes in water quality make it very hard to be optimally responsive,” Emelko says. “In fact, it can be a treatment operator's nightmare.”

Working closely with Uldis Silins, a University of Alberta professor who is her co-principal investigator with the watershed project, Emelko was involved in an emergency assessment of the threat to drinking water supply and treatment in Fort McMurray, a city of 80,000 people that draws its water from the Athabasca River. Step one was ensuring that the best support technology was made available to the utility. This is being followed by an exhaustive analysis of water in the river since the first significant rains began falling following the fires. The results will be key to determining how technology in the treatment plant can best be tweaked and supported to produce clean, safe water. As they determine the risks and plan an optimal response to them, Emelko says they simply aren't sure if the treatment plant in Fort McMurray will be up to the task of producing enough water to supply the city; however, they remain hopeful because they have access to the treatment technologies that are believed to have the greatest chance of overcoming the expected challenges.

Emelko, whose other main colleague at the watershed project is Mike Stone, Water Institute member and a professor in Waterloo's Department of Geography and Environmental Management, says the Fort McMurray situation highlights pressing needs to develop “real-time” water-testing technologies and employ “resilient engineering” in treatment facilities. 💧



Kluane First Nation youth, using the latest sampling and analysis techniques in a Waterloo lab, found very low levels of mercury in fish.

WATERLOO BIOLOGIST AND FIRST NATION EXAMINE MERCURY IN FISH

Featuring Heidi Swanson, Biology

Mercury is a potent neurotoxin and is of particular concern in the Canadian north, because eating fish is most often the largest source of mercury for humans, and northerners often rely on fish as a subsistence food source. Understanding why concentrations of mercury in fish are increasing in some Arctic lakes and are stable or decreasing in others, is of great interest to Water Institute member Heidi Swanson. A professor in the Department of Biology and a University Research Chair in the Faculty of Science, she uses science, indigenous knowledge and field-based learning to untangle the complexities of water, fish and ecosystem interactions in seeking to understand how climate change and resource development is impacting mercury accumulation in northern aquatic ecosystems, and, ultimately, human health.

In 2015, Swanson and her team, which included Kluane First Nation youth, collected over 200 fish samples from Kluane Lake, Yukon Territory, as part of a larger project on Kluane First Nation's food security strategy. In addition to the field sampling, the First Nation youth also conducted interviews with community elders about historical catch counts, changes in fish taste and texture, and traditional hunting grounds and processing methods. In March 2016, the First Nation youth visited Swanson's lab at the University of Waterloo to learn more about the scientific testing done with fish samples they collected during 2015.

"It's exciting to have the young people analyze samples from their own lake and understand the ecosystems much more deeply. It's an experience they will never forget,"

says Norma Kassi, the Director of Indigenous Collaboration for the Arctic Institute of Community-Based Research.

"This is the way science should take place, especially in the Arctic regions. When they're canoeing on their lake and hunting, they're going to have a deeper understanding and a deeper respect for what they've learned."

While Swanson's team has linked mercury accumulation in fish to size, age and trophic position, differences among lakes are more complicated, and might be linked to past fishing practices, the rate of fish growth, feeding habits, or the removal of beaver dams. Ongoing research aims to confirm documented temporal trends, investigate what is causing the trends (e.g., water chemistry, food web structure), and predict how fish mercury concentrations in this region may respond to continued anthropogenic stressors, such as climate change. For the Kluane First Nation, however, preliminary results from the 2015 sampling are encouraging.

"It's a good news story — these youth are combining the best of both the scientific and traditional worlds and taking charge of their future," says Swanson, "I've never seen northern lake trout with lower levels of mercury than those from Kluane Lake." 🐟

LEE KUAN YEW PRIZE

2016

AWARD CEREMONY & BANQUET



Earth and Environmental Sciences distinguished professor emeritus is awarded prestigious Lee Kuan Yew Water Prize at Singapore International Water Week.

WATERLOO GROUNDWATER LEADER RECEIVES PRESTIGIOUS WATER PRIZE

Featuring John Cherry, Earth and Environmental Sciences

In 2016, John Cherry, University of Waterloo distinguished professor emeritus, received the prestigious Lee Kuan Yew Water Prize. Cherry, who spent his career dedicated to groundwater management and protection, received the honour in the company of water experts from around the world, including a Waterloo delegation, at Singapore International Water Week. The honour came with a prize of more than \$280,000 CDN.

“It is a great honour for me to be the 2016 recipient of the Lee Kuan Yew Water Prize,” Cherry said in his acceptance speech. “I am most pleased because this prize granted to me draws attention to the importance of groundwater in the global water crisis.”

Cherry, who joined Waterloo’s Department of Earth and Environmental Sciences in 1971, conducted revolutionary research that led to a better scientific understanding of groundwater processes, the development of new groundwater remediation techniques and guidelines, as well as the development of more effective risk management approaches in groundwater pollution control.


“This is wonderful news,” said then Earth and Environmental Sciences Chair Bill Taylor.

“John Cherry is one of the outstanding faculty

members who made the Department of Earth and Environmental Sciences a world leader in the area of hydrogeology.”

During his three decades with the department, Cherry became best known for co-authoring groundwater hydrology’s standard textbook *Groundwater* with R.A. Freeze in 1979.

“It is because of the legacy of John Cherry and others that the University established the Water Institute,” said Roy Brouwer, executive director of the Institute. “The Lee Kuan Yew Water Prize honours some of the most outstanding contributions towards solving the world’s water challenges.”

Cherry actively participated in the development of technologies for improving groundwater monitoring and remediation for which he co-holds several patents. In the 1980s, he established the Borden Groundwater Field Research Facility which is used by many researchers internationally to study groundwater flow as well as the movement and fate of contaminants in the subsurface. 

SEED GRANTS PROGRAM

After several years of administering an interdisciplinary workshop program, in 2014/15, we launched our expanded Water Institute Seed Grants Program. The program stimulates interdisciplinary collaboration, facilitates interaction with national and international authorities, and encourages the development of research proposals. The 2015/16 competition awarded a total of \$150,000 to eight diverse projects:

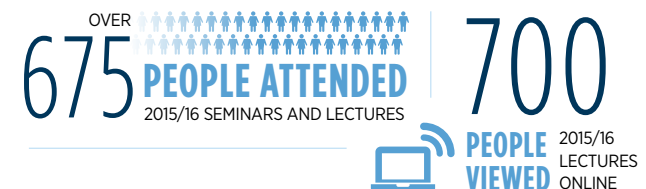
- » *Boomerang Effect: Climate change adaptation, organized violence and regional (in)security* (L. Swatuk, Environment, Enterprise and Development)
- » *Catching Ripples in the Water: A social-ecological regime shifts approach to understand abrupt changes in coastal watersheds and crafting governance arrangements* (P. Nayak, Environment, Enterprise and Development)
- » *Do Watershed Biogeochemical Models Really Inform Coastal Ecology and Environmental Policy? Assessing knowledge gaps and charting the way forward in linking hydrology, biogeochemistry and land use to coastal ecosystem functions and environmental impacts* (P. Van Cappellen, Earth and Environmental Sciences)
- » *Establishment of the First and Most Detailed Account of Lake-levels in the Peace-Athabasca Delta: A key hydrologic node of the Mackenzie River Basin, northwestern Canada* (J. Johnston, Earth and Environmental Science)
- » *Implementing an Open Access GIS and Satellite Imaging System to Inform Health System Spatial Planning in Western District, Zambia* (C. Janes, Public Health and Health Systems)
- » *Improving Weather Forecasting Models with Satellite Data Assimilation: A new initiative at University of Waterloo* (H. Kheyrollah Pour, Geography and Environmental Management)
- » *Public Perception and Priorities for Safe Water in Accra, Ghana* (E. Bisung, Geography and Environmental Management)
- » *Reactive Interfaces in Agroecosystems: Meta-analysis and uncertainty analysis of biogeochemical functions in agricultural landscapes* (P. Van Cappellen, Earth and Environmental Sciences)

In 2016/17, a total of \$150,000 will be made available through the Water Institute Seed Grants Program, catalyzing interdisciplinary collaboration and stimulating creative and unconventional thought. 💧

WATERTALKS LECTURE SERIES

Consistent with our mandate to facilitate knowledge sharing, in 2015/16 we organized a well-attended *WaterTalks* lecture series, featuring high-profile, invited speakers. These were Livestreamed and videotaped, expanding options for viewers to watch remotely, as well as on-demand. Professors, for example, used them to augment their course curricula. The 2015/16 *WaterTalks* were:

- » **PRABHAKAR CLEMENT**, Harold Vince Groome Endowed Professor, Department of Civil Engineering, Auburn University, Auburn, Alabama
Worthiness of Complex Groundwater Models for Decision-making: When should we say enough is enough?
- » **DUSTIN GARRICK**, Assistant Professor and Philomathia Chair of Water Policy, Department of Political Science and Booth School of Engineering Practice, McMaster University, Hamilton, Ontario
Pathways to Water Security for Rivers Under Pressure: Water markets and transboundary governance in Australia and Western North America
- » **SUSAN HUBBARD**, Associate Lab Director, Earth and Environmental Sciences, Lawrence Berkeley National Laboratory, Berkeley, California
New Approaches for Characterizing Watershed Structure and Function
- » **SHARACHCHANDRA LÉLÉ**, Senior Fellow, Asoka Trust for Research in Ecology and the Environment, Bangalore, India
Bridging Many Divides: Building an interdisciplinary understanding of water issues in a developing country context
- » **JOHN REYNOLDS**, Professor of Aquatic Ecology and Conservation, Tom Buell B.C. Leadership Chair in Aquatic Conservation, Simon Fraser University
Salmon-fuelled Ecosystems of the Great Bear Rainforest 💧



EXTERNAL PARTNERS PROGRAM

We launched our External Partners Program in 2013 to facilitate partnerships between researchers and members of the private sector, government, civil society or other organizations that have a particular interest in the water sector. Four levels of membership are available to our partners — platinum, gold, silver and bronze — with commensurate benefits. We currently have connections with over 400 external partners.

Depending upon the membership level, benefits can include:

- » water-related information and news
- » invitations to the Institutes' *WaterTalks* seminar series
- » introductions to relevant Waterloo researchers to provide opportunities for collaboration
- » invitations to the annual Water Institute Research Symposium and RBC Distinguished Lecture
- » support for student recruiting activities, such as a World Water Day booths and employment forums
- » recognition through Institute graduate scholarships (platinum partners only)
- » recognition and acknowledgment of membership and scholarship support on the Institute website and at the research symposium

We sincerely appreciate the support of our 2015/16 platinum, gold and silver partners. 🌊

Platinum Level



Gold Level



Silver Level



“Golder Associates is a proud partner of the Water Institute. Interaction with the Institute’s interdisciplinary researchers informs us of state-of-the-art, innovative developments; this helps in our service to clients and links us to Waterloo’s students, who represent an important source of top talent.”

— **DAVID SMYTH**

Principal and Senior Hydrogeologist at Golder Associates Ltd.

RESEARCH CHAIRS

We currently have 18 prestigious research chairs:

CANADA EXCELLENCE

PHILIPPE VAN CAPPELEN
Ecohydrology

CANADA

DAVID BLOWES
Groundwater Remediation

ZHONGWEI CHEN
Advanced Materials for Clean Energy

BRIAN DIXON
Fish and Environmental Immunology

FRANK GU
Advanced Target Delivery Systems

JANUSZ PAWLISZYN
New Analytical Methods and Technologies

MARK SERVOS
Water Quality Protection

MARIA STRACK
Ecosystems and Climate

ALEXANDER WONG
Medical Imaging Systems

JOHN YEOW
Micro and Nanodevices

INDUSTRIAL

PETER HUCK
Water Treatment

JANUSZ PAWLISZYN
New Analytical Methods and Technologies

UNIVERSITY

PU CHEN
Nano-Biomaterials

CLAUDE DUGUAY
Cryosphere and Hydrosphere from Space

XIANSHE FENG
Membrane Science and Technology

DANIEL SCOTT
Global Change and Tourism

HEIDI SWANSON
Freshwater Ecology

MICHAEL TAM
Functional Colloids and Nanomaterials

CENTRE FOR GOVERNANCE AND INNOVATION

THOMAS HOMER-DIXON
Global Systems



education

TOTAL NUMBER OF CWP STUDENTS PER YEAR:



26

IN 2013/14



29

IN 2014/15



48

IN 2015/16

The promotion of interdisciplinary education is our second core purpose. This section details progress in specific areas intended to support education goals and objectives.

COLLABORATIVE WATER PROGRAM

The University of Waterloo's Collaborative Water Program (CWP) was launched in 2014 to promote interdisciplinary perspectives on water. This innovative program, jointly offered by 10 academic departments, is coordinated and supported by the Institute. CWP students complete their specialist training in their respective home departments, while learning with colleagues, from a variety of other departments, in two interdisciplinary courses that are specifically designed for the program: Integrated Water Management and Integrated Water Project.

Collaborative Water Program students seine fishing at Bellwood Lake.

During 2015/16, key CWP activities included:

- » Bruce MacVicar, Assistant Professor in the Department of Civil and Environmental Engineering, assumed the role of CWP Director for a two-year term.
- » The second cohort (2014/15) of 29 CWP students completed WATER 602, which uses the Grand River watershed as a “living laboratory” to study basin characteristics and issues from a variety of perspectives. The course included a mix of field trips, group and individual work. Students completed CWP-specific requirements by presenting their research at our research symposium.
- » The third cohort (2015/16) of 48 CWP students participated in an annual leadership retreat. The two-day retreat was held at a local YMCA camp, and included a variety of team-building and collaboration exercises. The students then completed WATER 601, a case-study oriented course that used peer-to-peer learning in exploring water issues from a variety of disciplines and perspectives.

The continuing success of the CWP is a major achievement for the Institute in support of its goal to promote interdisciplinary education. With an estimated fourth cohort (2016/17) of over 40, the CWP continues to gain momentum as faculty, students and employers recognize the value of training broad-minded specialists.

Currently, departments and schools participating in the CWP are:

- » Applied Mathematics
- » Architecture
- » Biology
- » Chemical Engineering
- » Civil and Environmental Engineering
- » Earth and Environmental Sciences
- » Economics
- » Environment, Resources and Sustainability
- » Environment, Enterprise and Development
- » Geography and Environmental Management

“The goal is for our students to get the most out of their university experience. They make connections with peers and established researchers, not only in their fields but across campus and beyond. We give them the language, understanding and interpersonal skills to communicate with each other and work in teams. Ideally, they become transdisciplinary researchers and thus able to tackle big ‘wicked’ problems like food security, ecosystem resilience and climate change — issues likely to define water issues in the next century.”

— **BRUCE MacVICAR**
Director, Collaborative Water Program

RBC VISITING FELLOWS PROGRAM

The purpose of the Institute’s RBC Visiting Fellows Program is

1. to enrich the learning experience of Collaborative Water Program students specifically, and the broader graduate and undergraduate water student population more generally, and
2. to stimulate discussion and the exploration of collaborative research opportunities with Institute faculty.

The fellows program, launched in 2014/15, attracts recognized national and international water researchers, thought leaders and professionals, experienced in multi- or inter-disciplinary approaches to addressing water challenges. During 2015/16, the Institute was honoured to host the following RBC visiting fellows from the Ashoka Trust for Research in Ecology and the Environment in Bangalore, India:

- » Sharachchandra Lélé
- » Priyanka Jamwal
- » Bejoy Thomas
- » Veena Srinivasan

STUDENTS OF THE WATER INSTITUTE, GRADUATE SECTION

The Students of the Water Institute, Graduate Section (SWIGS) was established in 2010 to promote interdisciplinary water research and learning among graduate students from the various faculties. By 2015/16, SWIGS had several hundred student members from across all six faculties. Under the leadership of the SWIGS executive, a variety of academic, social and outreach events, focused on water-related themes, were successfully organized and well attended. Of particular note, was the annual World Water Day Graduate Research Fair organized and co-hosted by the Institute, SWIGS and Wilfrid Laurier University. This event featured graduate student posters, industry booths, keynote speakers and a networking reception.

The 2015/16 SWIGS Executive team included:

- » Chair: **CATHERINE BROWN**, Geography and Environmental Management
- » Vice Chair Conference: **STEPHANIE BARR**, Environment, Resources and Sustainability
- » Vice Chair Operations: **LAUREN SMITH**, Environment, Enterprise and Development
- » Vice Chair Outreach: **KATIE McCANN**, Biology
- » Vice Chair Social: **NICOLE BALLISTON**, Geography and Environmental Management

“Water researchers need to engage and communicate with the public, industry leaders and elected officials to elevate understanding of critical water issues. I am impressed that the Water Institute recognizes that communicating the scientific contributions of its members, is one of its key responsibilities.”

– **JAY FAMIGLIETTI**

*Professor of Earth Systems Science, University of California Irvine
JPL Senior Water Scientist, NASA Jet Propulsion Laboratory, California Institute of Technology*

RESEARCH SYMPOSIUM AND RBC DISTINGUISHED LECTURE

We held our fourth annual research symposium on April 28, 2016 with over 140 people attending. It is designed to showcase the breadth of Waterloo’s water research, focusing on areas of particular interest to external partners and providing opportunities for them to interact with our researchers and students.

The 2016 symposium included an opening plenary roundtable: “Knowledge Co-Production: What does it mean in practice?” featuring participants from the Canadian Federation of Agriculture, Canadian Environmental Law Association and the Science Media Centre of Canada. Subsequent breakout sessions showcased innovative Waterloo water research in a number of departments and areas. A closing plenary featured an in-depth look at three research projects from Institute faculty members that received significant scientific and media attention over the past year because of their quality and impact. A particular highlight of the day was the presentation of graduate student water scholarships and several “three-minute thesis” presentations by students of SWIGS.

The symposium was followed by our RBC Distinguished Lecture, graduate student poster session and reception. The Institute was honoured to present Jay Famiglietti, professor of earth systems science at the University of California Irvine and JPL senior water scientist at the NASA Jet Propulsion Laboratory at the California Institute of Technology, as its 2016 RBC Distinguished Lecturer. Famiglietti has been researching and communicating about water and climate change — in academia, in business, in government and to the general public — for over 25 years. Famiglietti’s lecture, “Water and Sustainability: 21st century realities and the global groundwater crisis” described how his research team uses satellites and develops computer models to track changing freshwater availability and groundwater depletion around the world.



Jay Famiglietti presents on water and sustainability at the Institute's annual research symposium.

WATER INSTITUTE SCHOLARSHIP RECIPIENTS 2015/16

We are most grateful to the platinum members of our External Partners Program for their generous contributions in the form of graduate student scholarships.

AECOM GRADUATE SCHOLARSHIPS IN WATER RESEARCH

KEEGAN HICKS *PhD Candidate, Biology*

SHABNAM MOSTOFI ZADEH *PhD Candidate, Civil and Environmental Engineering*

GOLDER ASSOCIATES GRADUATE SCHOLARSHIPS IN WATER RESEARCH

PIETER AUKES *PhD Candidate, Earth and Environmental Sciences*

ALLISON TURNER *MES Candidate, Environment, Resources and Sustainability*

STANTEC GRADUATE SCHOLARSHIPS IN WATER RESEARCH

KIMBERLEY MURRAY *MSc Candidate, Geography and Environmental Management*

RBC WATER SCHOLARS

A major portion of the RBC Foundation grant, in support of the Collaborative Water Program, is committed to entrance scholarships. The 2015/16 group of RBC Water Scholars includes:

SABRINA BEDJERA *MASc Candidate, Civil and Environmental Engineering*

NAVID BIZMARK *PhD Candidate, Chemical Engineering*

FREDERICK CHENG *MASc Candidate, Civil and Environmental Engineering*

ROBERT CHLUMSKY *MASc Candidate, Civil and Environmental Engineering*

RACHEL COHEN-MURISON *MArch Candidate, Architecture*

KARINE DAVID *PhD Candidate, Environment and Resource Studies*

SAFIRA LAKHANI *MArch Candidate, Architecture*

DANIELLE LINDAMOOD *MES Candidate, Environment, Enterprise and Development*

SEAN MORRISON *MSc Candidate, Earth and Environmental Sciences*

THOMMASO RASO *MASc Candidate, Civil and Environmental Engineering*

JUN SIM *PhD Candidate, Civil and Environmental Engineering*

SNEHANJALI SUMANTH *MArch Candidate, Architecture*

ALLISON TURNER *MES Candidate, Environment, Resources and Sustainability*



priorities for 2016/17

Rendering of a New Orleans house with an amphibious retrofit. Elizabeth English, from the School of Architecture, researches "amphibious" floatable houses that rise and fall with flood waters.

Several goals and objectives have been established for 2016/17 as we continue to implement our renewed strategic plan. Within this context, the following activities will receive particular attention in 2016/17:

RESEARCH

- » revise and refine Institute research themes
- » assist in development of major research proposal
- » facilitate new or strengthened international partnerships
- » administer Water Institute Seed Grants Program
- » manage RBC Visiting Fellows Program
- » organize *WaterTalks* lecture series
- » manage External Partners Program

EDUCATION

- » co-ordinate and support Collaborative Water Program
- » organize Water Institute Research Symposium and RBC Distinguished Lecture
- » support Students of the Water Institute, Graduate Section

PROFILE

- » recruit inaugural communications officer
- » develop and implement renewed communications plan
- » launch new Institute website
- » secure new physical space on central campus

VISITING DELEGATIONS 2015/2016

- » Hohai University, China
- » BCEG Environmental Remediation Co. Ltd., China
- » Sorbonne, France
- » Counsellor, Science and Technology, Chinese Embassy in Ottawa
- » Adama Science and Technology University, Ethiopia
- » Asia Pacific Foundation, Canada
- » Israel Ambassador to Canada
- » Alberta Energy Regulator
- » Minister of Education, Aruba

WATER INSTITUTE SEMINARS AND LECTURES

JUNE 17, 2015

T. PRADEEP, Professor, Chemistry, Indian Institute of Technology Madras, India
Affordable Clean Water using Nanomaterials

OCTOBER 29, 2015

DUSTIN GARRICK, Assistant Professor and Philomathia Chair of Water Policy, Department of Political Science and Booth School of Engineering Practice, McMaster University
Pathways to Water Security for Rivers under Pressure: Water markets and transboundary governance in Australia and western North America [YouTube](#)

NOVEMBER 12, 2015

VIKRAM SONI, Professor and UGS Emeritus Fellow, Centre for Theoretical Physics, Jamia Millia Islamia, India
Towards Self-Sustaining, Natural Cities: Floodplain recharge and subterranean mineral water in India

NOVEMBER 19, 2015

GUSTAAF JACOBS, Professor, Aerospace Engineering, San Diego State University, U.S.
Lagrangian Coherent Structures and DNS with Discontinuous Galerkin Methods

NOVEMBER 26, 2015

JOHN REYNOLDS, Professor of Aquatic Ecology and Conservation, Tom Buell B.C. Leadership Chair in Aquatic Conservation, Simon Fraser University
Salmon-fuelled Ecosystems of the Great Bear Rainforest [YouTube](#)

JANUARY 28, 2016

SHARACHCHANDRA LÉLÉ, Senior Fellow, Ashoka Trust for Research in Ecology and the Environment, India

Bridging Many Divides: Building an interdisciplinary understanding of water in a developing country context [YouTube](#)

FEBRUARY 22, 2016

PRIYANKA JAMWAL, Fellow, Ashoka Trust for Research in Ecology and the Environment, India

Rethinking the Framework for Regulating Water Quality in Urbanizing Watersheds

FEBRUARY 25, 2016

SUSAN HUBBARD, Associate Lab Director, Earth & Environmental Sciences, Lawrence Berkeley National Laboratory, Berkeley, California, U.S.

New Approaches for Characterizing Watershed Structure and Function [YouTube](#)

MARCH 14, 2016

ERIC PETERSON, Founder and Executive Director, Hakai Institute, Heriot Bay, Canada

Wired Watershed: Hakai's critical zone observatory on B.C.'s coastal margin

MARCH 24, 2016

PETER MOLLINGA, Professor, School of Oriental and African Studies, University of London, U.K.

Downstream of the Dam: Farmers, pipelines and capitalist development in the Sardar Sarovar project

MARCH 28, 2016

BEJOY THOMAS, Fellow, Ashoka Trust for Research in Ecology and the Environment, India

Resilience, Vulnerability and Environmental Change: Insights from the rapidly urbanizing Arkavathy sub-basin, India

MARCH 31, 2016

PRABHAKAR CLEMENT, Harold Vince Groome Endowed Professor, Department of Civil Engineering, Auburn University, U.S.

Worthiness of Complex Groundwater Models for Decision-making: When should we say enough is enough? [YouTube](#)

APRIL 1, 2016

PRABHAKAR CLEMENT, Harold Vince Groome Endowed Professor, Department of Civil Engineering, Auburn University, U.S.

Authorship and Author Rank: Misuses, misunderstandings and a meaningful solution

APRIL 6, 2016

VEENA SRINIVASAN, Fellow, Ashoka Trust for Research in Ecology and the Environment, India

The Case for Problem-driven Water Research in the Developing World: Lessons from India


APRIL 28, 2016

JAY FAMIGLIETTI, Professor, Civil Engineering and JPL Senior Water Scientist, University of California, Irvine / NASA Jet Propulsion Lab, California Institute of Technology

Water and Sustainability: 21st century realities and the global groundwater crisis [YouTube](#)

EXTERNAL ADVISORY BOARD

The purpose of the External Advisory Board is to provide an independent and external evaluation of our progress and provide recommendations and support to help meet our goals. The Board held its annual meeting on May 12, 2015 and reported findings to our Senior Management Committee. Current members of the External Advisory Board are:

- » **TONY MAAS** (Chair), Principal
Maas Strategies, Kitchener, Ontario
- » **JOHN COBURN**, Partner
XVP Water Partners, Toronto, Ontario
- » **ROBERT LEECH**, Environment Practice Lead
AECOM, Markham, Ontario
- » **MICHAEL MURRAY**, Chief Administrative Officer
Region of Waterloo, Kitchener, Ontario
- » **JEFFREY MCDONNELL**, Associate Director, *School of Environment and Sustainability* and Assistant Director, *Global Institute for Water Security, University of Saskatchewan, Saskatoon, Saskatchewan*
- » **MERRELL-ANN PHARE**, Executive Director/Legal Counsel
Centre for Indigenous Environmental Resources, Winnipeg, Manitoba
- » **GEORG TEUTSCH**, Scientific Director
Helmholtz Centre for Environmental Research – UFZ, Leipzig, Germany 

WATER INSTITUTE MEMBERS

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Computer Science

William A. Anderson
Chemical Engineering

William B. Anderson
Civil and Environmental Engineering

William Annable
Civil and Environmental Engineering

Ramon Aravena
Earth and Environmental Sciences

Derek Armitage
Environment, Resources and Sustainability

Gladimir Baranoski
Computer Science

James Barker
Earth and Environmental Sciences

Nandita Basu
*Earth and Environmental Sciences;
Civil and Environmental Engineering*

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Architecture

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Lingling Wu
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John Yeow
Systems Design Engineering

Youngki Yoon
Electrical and Computer Engineering

Aiping Yu
Chemical Engineering

“Since its inception, the Water Institute has served as a catalyst for interdisciplinary and inter-institutional collaboration so important in addressing today’s complex water security issues. In 2015/16, I was particularly delighted that Roy Brouwer joined the Institute as its third executive director. I am convinced that, under his leadership, the Water Institute will further increase its profile and impact over the coming years.”

— DR. GEORGE DIXON

Vice-President, University Research, University of Waterloo

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