



SPLASH PAD

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WATERLOO



BOB GILLHAM
Executive Director
the Water Institute

Tackling the Big Problems

The word “interdisciplinary” is sprinkled liberally throughout the strategic plan and other governance documents of the Water Institute. Indeed, development of an interdisciplinary capacity in research and teaching was a founding tenet of the Institute. Now, as I depart the Institute after almost four years as Executive Director, it is perhaps natural to reflect on the degree to which we have met our goals, and in particular, on the degree to which we have met our interdisciplinary aspirations. While considering this question, the September issue of Nature was brought to my attention. It is a special issue devoted to interdisciplinarity, with discussions on the importance of interdisciplinary research, structural impediments to adoption, requirements for implementation and related topics. Not surprisingly, several articles note that in order to address large problems, an interdisciplinary approach is required. “Water” has large problems!

Though the numbers vary widely, in 2011, UNICEF estimated that 760,000 children under the age of 5 die each year from water-borne disease. Further, Dr. Peter Glick of the Pacific Institute estimated that 76 million people (all ages) will die from similar causes during the period 2002 to 2020, and maintained that the rate of deaths would continue to increase, even if the Millennium Development Goals are met. This situation is seldom (if ever) in the headlines or on the evening news, yet it is surely the major tragedy of our time and a morally unacceptable condition. It is all the more tragic because the technology to purify water is highly developed; clearly, technology on its own will not solve the problem. A host of other disciplines is required in order to effectively identify, install, administer and maintain the appropriate technologies. Governance, public administration, law, finance, public health and psychology are but a few of the relevant disciplines. Improving the health of underprivileged and under developed communities is a major challenge and one requiring a greater interdisciplinary and international effort.



UNIVERSITY OF
WATERLOO






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There is no shortage of big problems. In semi-arid regions, irrigation can increase crop production by a factor of two to four. It is therefore not surprising that the area of land under irrigation has increased by close to a factor of three since the 1960s, to about 301 million hectares. About 38% of the irrigated area receives groundwater, at about 734 cubic km per year, with India, China and the US having the greatest irrigated areas. Thus, with greatly increased production, the use of groundwater for irrigation has made a significant contribution to food security and has substantially improved the standard of living for millions of families. Unfortunately, for many aquifers, particularly those in the semi-arid regions, water is being withdrawn at unsustainable rates. Wada et al. (2012) estimated that globally, groundwater abstraction exceeds recharge by about 34%. Clearly this is not sustainable, and at some time in the future, the aquifers will be depleted. Gleeson et al. (2012) estimated that 1.7 billion people, or approximately 25% of the global population, live in areas where groundwater resources are under threat. As aquifers become depleted it is inevitable that standards of living will decline, populations in many areas will necessarily decline and civil unrest and conflict may ensue. The problem brings water security and food security face-to-face and involves a complex interaction of technical, social and political issues. Clearly, if many potentially tragic circumstances are to be avoided, strong interdisciplinary intervention is required.

Adaptation to climate change, preparedness for extreme events, consequences of urbanization and hydrologic sustainability of oil sands development are but a few of the many large “water” problems requiring an interdisciplinary approach. Indeed, because of the public interest in water, there are few water management activities, big or small, that

do not require the perspectives and knowledge of several disciplines. Progress towards solutions will proceed more effectively if there is mutual respect and understanding among the relevant disciplines.

So how is the Institute doing? Most members are trained within the bounds of a particular discipline and the departmental structure of the university is not conducive to interdisciplinarity. However, the Institute cuts across departmental boundaries and is therefore in a favourable position to encourage interdisciplinarity. Through supporting activities such as the Seed Grants program, the annual symposium, lecture series and member participation on various committees, I believe a cultural change is in progress. I believe it is still the case however that many members continue to be more comfortable within the confines of their particular discipline.

A significant bright spot is the Collaborative Water Graduate Program (CWP). The program was designed to give students an interdisciplinary perspective, without diluting their disciplinary skills. The concept has received enthusiastic support from our industrial partners, and discussions with instructors and students confirm that the program has been remarkably successful in meeting its objectives. It is important that the University, recognize the uniqueness and value of the program and that the resources be available to insure its continuation. We must have hope that this new generation of graduates will be better equipped to address our “big water problems”. 

Gleeson, T., Y. Wada, M.F.P. Bierkens, and L.P.H. van Beek (2012), Water balance of global aquifers revealed by groundwater footprint, *Nature*, 488, 197-200, doi:10.1038/nature11295.

Wada, Y., L.P.H. van Beek, and M.F.P. Bierkens (2012), Nonsustainable groundwater sustaining irrigation: A global assessment, *Wat. Resour. Res.*, 48, W00L06, doi:10.1029/2011WR010562.



water researchers in the news

PHILIPPE VAN CAPPELLEN NAMED FELLOW OF ROYAL SOCIETY OF CANADA



Philippe Van Cappellen, Professor, Earth and Environmental Sciences

Philippe Van Cappellen, Professor, Earth and Environmental Sciences and Canada Excellence Research Chair in Ecohydrogeology, has been elected to be a Fellow of the Royal Society of Canada. The fellowship of the Royal Society of Canada consists of individuals who have made outstanding contributions in the arts, the humanities, science,

and Canadian public life. Fellows are elected by their peers in recognition of outstanding scholarly, scientific and artistic achievement. Philippe's research is focused on the biogeochemistry of soils, sediments and aquatic ecosystems, the cycles of water, carbon nutrients and metal, global change and geobiology. In addition to fundamental contributions concerning surface precipitation theory for the formation of minerals, he is widely acknowledged as a pioneer in the development and application of reactive transport modeling to complex aqueous geochemical systems.

Philippe is one of four professors from the University of Waterloo who will be inducted to the Royal Society of Canada this fall in Victoria. He joins a distinguished group of Water Institute members who are already Fellows:

- » **Robert Gillham**, Distinguished Professor Emeritus, Earth and Environmental Sciences and Executive Director, the Water Institute;
- » **Keith Hipel**, University Professor, Systems Design Engineering, and President, RSC Academy of Science;
- » **Bruce Mitchel**, Professor, Geography and Environmental Management;

» **Janusz Pawliszyn**, Professor, Chemistry;

» **Edward Sudicky**, Professor, Earth and Environmental Sciences. 🌊

uwaterloo.ca/science/news/science-cercs-david-cory-and-philippe-van-cappellen-named

PU CHEN NAMED FELLOW OF CANADIAN ACADEMY OF ENGINEERING

Pu Chen, Professor, Chemical Engineering, has been elected to the Canadian Academy of Engineering. Pu holds the Canada Research Chair in Nano-Biomaterials and was also named a University Research Chair this fall. The Canadian Academy of Engineering comprises many of the country's most accomplished engineers, who have expressed their dedication to the application of science and engineering principles in the interests of the country and its enterprises. Pu's research has contributed to theoretical underpinnings and practical applications in low dimensional thermodynamics, interfacial and nanostructure design and fabrication, peptide self/co-assembly, and energy storage and conversion. 🌊

uwaterloo.ca/engineering/news/pu-chen-and-ming-yu-elected-fellows-canadian-academy

FEREIDOUN REZANEZHAD AWARDED MERCATOR FELLOWSHIP

Fereidoun Rezanezhad, Research Assistant Professor, Ecohydrology Research Group, Earth and Environmental Sciences, has been selected to be a Mercator Fellow in the new Baltic TRANSCOAT Research Training Group located at Rostock University. The Baltic TRANSCOAT group investigates the water and solute exchange between land and sea across the coastal ecocline in an interdisciplinary team bringing together marine and terrestrial scientists. The Mercator Fellowship facilitates long-term project-based cooperation between German and international researchers. 🌊

technology and innovation

EXPLORING HYDROPONICS ON MARS

Exploring a foreign world such as Mars has many inherent complications and complexities. One of the largest hurdles is launch-mass which at present adds astronomical cost to anything involved with the mission, including astronaut's food. A Mars mission hydroponic system could reduce the required mass of transported food for long duration missions as well as subsequent supply missions. The mass of the hydroponic system itself would then be lower if its heaviest constituents, water and growing substrate, could be gathered on Mars by processing available resources such as the Martian soil and atmosphere. It is not surprising that these are already goals for NASA listed as Objectives Related to Preparation for Sustained Human Presence, Human Habitability/In-Situ Resource Utilization.

An experimental hydroponic system has been made and tested here at the University of Waterloo as a CIVE 486 class project. The project aimed to better understand the hydrologic parameters and resulting water balance of recirculating water within an enclosed hydroponic system using a soil similar to Martian soils. The experiment involved growing lettuce from seedlings in a small-scale hydroponic system sealed to the exterior environment for 13 days. The plants grew under red and blue shifted LED lights on a 14.5 hours per day cycle and had a simulated rain event every 2-3 days. The data logging system measured: air temperature and humidity, water temperature, soil moisture, and water level (ultrasonic sensing) of three distinct reservoirs, each corresponding to the rainfall, runoff, or infiltration/interflow. The data logging system consisted of peripheral analog and digital



Mars hydroponic system



Lettuce crop that was grown

sensors attached to a central microcontroller. Calibration of the system for the volume to water level relationship of each irregularly shaped reservoir and the temperature variance in the speed of sound was performed before the lettuce seedlings were added.


The rain event response was then modelled for the components of evapotranspiration (Priestly-Taylor Method), interflow (Green-Ampt Infiltration Model), and runoff (Manning's Sheet Flow Equation). These theoretical results were compared with the actual data to approximate the various parameters of the methods used. Additional testing under varied parameters would be useful in building a robust model to predict the specific components of the water balance under similar conditions in larger systems. More work is required to correctly model the flows under different gravity. Hopefully such a model will be put to the test on Mars in the near future.

This CIVE 486 project was conducted by Civil Engineering, Water Resources BASc students Thomas Stesco and Eric Kohnen who were supervised by Ric Soulis and course TA Ali Sarhadi. 💧

external partners program

WATER TODAY JOINS AS A GOLD EXTERNAL PARTNER


The Water Institute welcomes Water Today to our growing network as a new Gold External Partner.

Water Today is based in Ottawa and is an independent for profit media company focusing on water related issues in Canada. Its online presence, WaterToday.ca provides articles on water advisories, towns and people affected, water advisory reports, as well as more in depth water articles about First Nations, the Arctic, climate change, water/energy nexus and industrial contamination. Visit WaterToday.ca for more information. 

WATERTODAY.CA



EMPLOYMENT FORUMS RETURN

For a second year, the Water Institute is hosting Employment Forums for our External Partners to provide the opportunity to mix and mingle with Waterloo graduate students who focus on water. Interested students are invited to submit resumes online prior to the forums and they will be made available to External Partners. This is a great networking opportunity! The Forums will take place on the evenings of October 27, November 3 and November 4. The participating partners are AECOM, Golder Associates, Matrix Solutions, Stantec, WaterToday.ca and CH2M. 

attention graduate students

GRADUATE SCHOLARSHIPS IN WATER RESEARCH ARE AVAILABLE FOR THOSE CONDUCTING WATER RESEARCH



Five scholarships of **\$5,000 EACH** are available this year
DEADLINE NOVEMBER 5, 2015 AT 17:00

Scholarship Sponsors

AECOM

 **Golder Associates**

 **Stantec**

collaborative water program



Water 602 at the wastewater treatment plant in Elmira, Ontario. (photo by K. Hipel)

WATER 602 STUDENTS EXPLORE THE GRAND RIVER WATERSHED

The University of Waterloo's Collaborative Water Program (CWP) combines peer-to-peer learning, mentoring, and hands on experience to prepare the next generation of water managers and scholars to tackle the world's complex water issues. Following the success of last year's field trip component in Water 602, this year's program reinforced this experiential learning opportunity as a central aspect of the course. The course instructors, Mark Servos (Biology) and Simon Courtenay (Environment and Resources Studies), were supported by three PhD students (Maricor Arlos, Biology; Ghazal Memartoluie, Economics; Simone Philpot, Geography and Environmental Management), and numerous other faculty members, creating a dynamic and interdisciplinary leadership team. Twenty-eight students and facilitators travelled by bus (also known as the big yellow tin can) from the headwaters to the mouth of the Grand River Watershed and engaged with a wide variety of active water managers and stewards of the watershed. Guest speakers included representatives from utilities, industry, farmers, municipal and provincial government, NGOs, environmental activists, academics, and leaders from local government, First Nations and the Mennonite communities. It was an active week of learning that was concluded with a leadership exercise, highlighting the importance of collaboration and teamwork that is essential to managing water across interdisciplinary boundaries. ➡

RBC FELLOWS VISITING IN WINTER 2016

The Water Institute and the School of Environment, Enterprise and Development will be hosting, sequentially, four RBC Fellows from the Ashoka Trust for Research in Ecology and the Environment this winter. They will each be in Waterloo for about one month. They will participate in the Water 601 course and hope to interact with WI researchers across campus during their time here. If you would like to meet with any of these RBC Fellows during their time in Waterloo, please contact the Water Institute.

January 2016: Sharachchandra (Sharad) Lélé atree.org/sharad_lele

» Research Interests include: conceptual issues in sustainable development and sustainability, and analyses of institutional, economic, ecological, and technological issues in forest, energy, and water resource management. He attempts to incorporate strong interdisciplinarity into his research and teaching, which straddles ecology, economics, and political science.

February 2016: Priyanka Jamwal atree.org/priyankajamwal

» Research interests include: problems of water pollution, including point and non-point source pollution, biological and industrial contamination, and surface and groundwater. She is also interested in determining pollution abatement through wastewater treatment and contamination/decontamination approaches in water distribution networks.

March 2016: Bejoy Thomas atree.org/bejoy_thomas

» Research Interests include: development studies, political economy; water resources and society, multidisciplinary poverty and vulnerability, participation.

April 2016: Veena Srinivasan atree.org/VeenaSrinivasan

» Research interests include: inter-sectoral water allocation, threats to freshwater from local to regional to global scales, impacts of multiple stressors including demographics, climate change and urbanization on water resources, sustainable water management policy and practice, bi-directional feedbacks in human-water systems and comparative studies of socio-hydrologic systems. ➡

students of the water institute

GRADUATE SECTION

What a summer! Many were out conducting field research, but that didn't slow things down for SWIGS. Blue Drinks continued, as well as Let's Talk Science outreach, and a fun-filled water-themed afternoon (water fight and all!) with Waterloo International & Canadian Student Network.

Reunited, we have hit the ground running! In early September those in the Water 602 course of the Collaborative Water Program came together for a week-long field course, exploring the Grand River Watershed and various issues impacting the people, environment, and systems in this area. We dabbled in water treatment, remediation sites, agricultural land use, fish and benthic invertebrate sampling, dams, fisheries, canals, storm water management, and more!



Water 602 field trip: rafting adventures with Lorenzo Simonetti, Katie McCann, Behrad Gharedaghloo, Catherine Brown, Bereket Negasi, Tatjana Milojevic.



Water treatment demonstration at Open Streets Uptown Waterloo

In September, SWIGS hosted a booth at Open Streets Uptown Waterloo with an interactive demonstration of a waste water treatment plant, colouring pages, and plenty of information. Visitors young and old enjoyed seeing how their "dirty" water cups of glitter and beads were filtered and treated before returning to the stream.

UPCOMING EVENTS

Join us for our upcoming events.

» Laurel Creek Clean Up and BBQ

October 8th

Help bring the Great Canadian Shoreline Cleanup to Waterloo. Join SWIGS and help clean up our campus shoreline. Afterwards, join the SWIGS Executive team for the annual Welcome Back Lunch.

» UWEG & SWIGS Skill-Sharing Camping

Trip to Point Pelee National Park


October 15th - 18th

Ready to learn from your graduate Biology and Environment peers AND share your own knowledge? Join UWEG and SWIGS on the FIRST EVER camping and skill sharing trip to Point Pelee National Park. We have four groups planned — Plant-ID and Ethnobotany, Bird ID, Invertebrate ID, and Wildlife Photography/Storytelling.

» Blue Drinks



Come out to the Grad House and let's talk about water. Dates this fall are: **October 21, November 18,** and **December 9**, starting at 7:00 p.m. Watch the SWIGS Facebook page and twitter for reminders.

CONTACT US

 swigs.uwaterloo.ca (Find out more or contribute to our blog!)

 water.grad@uwaterloo.ca (Join our mailing list!)

 [facebook.com/uw.swigs](https://www.facebook.com/uw.swigs) (Engage in conversation!)

 [@UW_SWIGS](https://twitter.com/UW_SWIGS) (Updates at events and news of water interest!) 

Water talks

2015
2016
2:30 PM



OCTOBER 29, 2015

» **Dustin Garrick** | McMaster University

*Pathways to water security for rivers under pressure:
Water markets and transboundary governance in
Australia and western North America*



NOVEMBER 26, 2015

» **John Reynolds** | Simon Fraser University

Salmon-fuelled ecosystems of the Great Bear Rainforest



JANUARY 28, 2016

» **Sharachchandra Lélé** | Ashoka Trust for
Research in Ecology and the Environment

*Bridging many divides: Building an interdisciplinary
understanding of water issues in a developing country context*



FEBRUARY 25, 2016

» **Susan Hubbard** | Lawrence
Berkeley National Laboratory

*New approaches for characterizing
watershed structure and function*

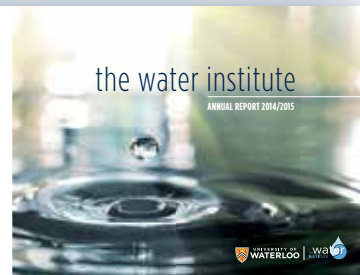


MARCH 31, 2016

» **Prabhakar Clement** | Auburn University

*Worthiness of complex groundwater models for decision
making – When should we say enough is enough?*

now available:
THE WATER INSTITUTE 2014-15 ANNUAL REPORT



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