



SPLASH PAD

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WATERLLOO



EMIL FRIND, Earth and Environmental Sciences Water Institute Member

the Waterloo moraine:

A SUSTAINABLE WATER SOURCE FOR WATERLOO REGION

Water sustainability is a challenge in many parts of the world. Extreme climate events brought about by climate change will make this challenge even more critical in the future. The persistent drought in the American Southwest is just one example.

Water sustainability is also a serious issue here at home. Waterloo Region, having been designated as a main growth centre by the Province of Ontario, is expected to grow by 50% over the next 30 years, yet the Region's water source, the groundwater of the Waterloo Moraine, is limited. Can groundwater be a sustainable source for a rapidly growing Region? This question is the topic of the Summer 2014 Special Issue "Water, Science and Policy" of the Canadian Water Resources Journal. The volume integrates science with socio-political aspects of water governance, concluding that the groundwater source will be sustainable for at least the next few decades. This is also the conclusion of the just-released Grand River Water Management Plan of the Grand River Conservation Authority.

Groundwater presently provides about 80% of the Region's water needs, the rest being surface water. The dependence on groundwater is seen by some as a constraint on the economic growth potential for the Region, so a Great Lakes (i.e. Lake Erie) pipeline has been proposed to overcome this constraint. This was reflected in the Region's Long-Term Water Strategy of 2000, which recommended a pipeline by 2035 to accommodate growth.

One of the papers of the Special Issue (Frind and Middleton) examines this option. A Lake Erie pipeline will cost well over a billion dollars to build, and its operating cost will be high. Other issues are a loss of local control, higher treatment costs, concerns about the carrying capacity of the Grand River for treated effluent, security, and the potential for toxic algae blooms in the Lake. Furthermore, switching to a pipeline-based supply would likely require shutting down the municipal wells, a disincentive for groundwater protection.

Accordingly, the preferred option is the groundwater source. To assure water sustainability, the Region has over the last two decades focused on balancing demand and supply. On the demand side, the Region has implemented water-saving measures that have together lowered water



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THE WATERLOO MORAINE, CONTINUED FROM PAGE 1

consumption from the Canadian average of 510 litres per capita/day to about 285 litres per capita/day. This makes Waterloo Region one of the most water-efficient communities in Canada. A rate of 160 litres per capita/day, close to the European average, is targeted for the year 2025.

On the supply side, the Region has successively optimized the groundwater source. Additional groundwater supplies have been developed, and demand peaks are being levelled out by using the Region's Aquifer Storage and Recovery System. Population growth will be accommodated by a combination of water efficiency programs and locally increased groundwater extraction, and recharge areas are to be protected. The overall result is that, for the foreseeable future, the supply matches the demand. The updated Region of Waterloo Water Supply Master Plan concludes that a pipeline to Lake Erie will not be needed before at least 2051.

This success story is discussed in the twelve papers of the CWRJ Special Issue, written by experts from government, universities, and private consultants, all with different backgrounds and expertise. A 3D hydrostratigraphic model of the Moraine based on new data provides the underlying geological

framework. This is combined with existing hydrogeological data to create a detailed picture of the complex moraine aquifer/aquitard system and its linkages to recharge areas and sensitive environmental features. Geochemical studies provide insight into the impact of human activities in urban and rural areas. The role of mathematical models is discussed in two papers, one chronicling the evolution of models over four decades while stressing the effects of conceptual uncertainties, and the other presenting a state-of-the-science groundwater model as a practical tool for resource management. A water budget shows that the projected municipal water demand to 2031 can be met with the existing well system without affecting groundwater discharge to streams and wetlands. The role of the Moraine's groundwater in sustaining environmentally sensitive areas and ecosystems, both within the Moraine area and downstream within the Grand River watershed, is highlighted in another paper. A paper examines the impact of threats to the quantity and quality of the Region's groundwater and develops a framework for threats assessment for different types and scales of threats. A policy paper describes how the Region has translated the science into science-based policy for protecting the Moraine water source while integrating environmental protection and source water protection. As a counterpoint to policy-based water governance, a further paper focusing on rural areas discusses how collaborative decision-making combines expert science, local knowledge, and community beliefs/values. A final paper discusses knowledge management in the context of the complex water resource-related problems with which we are being confronted.

The overall conclusion is that the Moraine groundwater source will be sustainable for at least the next forty years of growth. Beyond that, the Region's growth should be balanced with its key local resources, land and water. 💧

Emil Frind is a Distinguished Professor Emeritus in the Department of Earth and Environmental Sciences.
uwaterloo.ca/earth-environmental-sciences/people-profiles/emil-o-frind

WATER

water researchers in the news

DAVID BLOWES AWARDED NSERC CREATE

David Blowes, Earth and Environmental Sciences, leads a collaboration of researchers and industry that has been awarded an NSERC CREATE grant in the amount of \$1.65 million. The title of the NSERC CREATE is Training toward Environmentally Responsible Resource Extraction (TERRE). Several of the 11 co-applicants are WI members, including George Dixon, Carol Ptacek and Philippe Van Cappellen. Collaborators include 24 members from industry and academia, including WI members Hans Dürr, Walter Illman, Rebecca Rooney, David Rudolph, Heidi Swanson, Ed Sudicky, Neil Thomson and Andre Unger. The TERRE CREATE program has a training focus which is designed to provide a diverse breadth of knowledge to undergraduate and graduate students and post-doctoral fellows to enhance their ability to transition into high-caliber positions within the resource extraction industry. 🌊

uwaterloo.ca/science/news/waterloo-science-leads-165-million-sustainable-mineral

ROB DE LOË APPOINTED GREAT LAKES WATER QUALITY BOARD CO-CHAIR

This spring the IJC announced that Rob de Loë, Environment and Resource Studies, was appointed as the Canadian Co-Chair of the Great Lakes Water Quality Board.

The Water Quality Board is the principal advisor to the IJC in reviewing and assessing progress in implementation of the Great Lakes Water Quality Agreement, and in identifying emerging issues and approaches for preventing and resolving the complex challenges facing the Great Lakes. 🌊

IJC announcement: http://www.ijc.org/en/news?news_id=430

GRADUATE STUDENTS RECOGNIZED

Nancy Soontiens, Applied Mathematics, was awarded one of two Tertia Hughes Memorial Prizes for Best Thesis by the Canadian Meteorological and Oceanography Society for her PhD thesis which was titled “Stratified flow over topography: Steady nonlinear waves, boundary layer instabilities and crater topography”.

Shari Cater, Biology, will be awarded the Dr. Richard Playle Award for Outstanding MSc Thesis in Aquatic Toxicology at the annual Aquatic Toxicology Workshop in October. 🌊

THE FOLLOWING HAVE JOINED THE WI OVER THE PAST YEAR — WELCOME:

- » **Alexander Brenning** – Geography and Environmental Management
- » **Robert Case** – Renison University College
- » **Simon Courtenay** – Environment and Resource Studies
- » **Blair Feltmate** – Environment, Enterprise and Development
- » **Carrie Mitchell** – Planning
- » **Richard Petrone** – Geography and Environmental Management
- » **Simarjeet Saini** – Electrical and Computer Engineering
- » **Aiping Yu** – Chemical Engineering 🌊

FAREWELL TO:

- » **Richard Amos** has joined the Department of Earth Sciences at Carleton University.
- » **Tom Edwards** retired from the Department of Earth and Environmental Sciences this past spring and has moved to British Columbia.
- » **André Roy** stepped down as Dean of Environment in August to become the Dean of Arts and Science at Concordia University. 🌊

technology and innovation

A NEW TOOL TO CALCULATE IDF CURVES

Good estimates of peak rainfall statistics are essential for infrastructure design, hydraulic structure design, or flood plain mapping. Environment Canada provides peak rainfall intensities at selected Meteorological Services of Canada (MSC) stations. Previously in Ontario, if none of the 125 MSC station were close to a project, engineers performed manual interpolation to estimate design rainfalls. A team of University of Waterloo researchers, led by Dr. Soulis, recently created the Rainfall Intensity Duration Frequency (IDF) Curve Look-up Tool for the Ontario Ministry of Transportation (MTO), which interpolates the statistics automatically. Engineers save up to a day and a half per project but, most importantly, the consistent results greatly facilitate the approval process.

Previously, MTO provided IDF curves for each MTO District in a hard copy document developed with Environment Canada data up to 1989. The new web-based IDF Look-up tool is a powerful replacement to these documents. The tool provides IDF curves electronically for any location across the Province and uses up-to-date data from Environment Canada.

The tool uses the MSC classically produced IDF curve parameters. It then uses the Square Grid Technique, so-named as it treats UTM grid squares as elementary control volumes. Topographic parameters are used as interpolators of surface fields of interest such as temperature, runoff and, in this case, IDF curve parameters A and B. To ensure unbiased station data, the tool weighs the data based on the record length of stations. The tool uses USGS GTOPO-30 DEM to derive physiographic characteristics that become independent variables in a regression analysis with station statistics. These then produce generating equations for a gradually varying regional IDF curve.

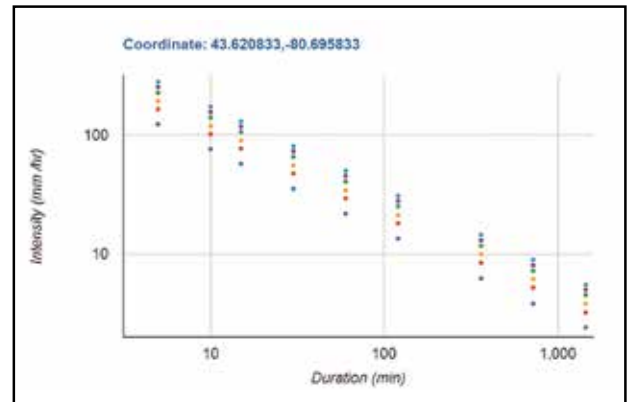


Figure 1: A sample IDF Curve showing 2-year through 100-year storms

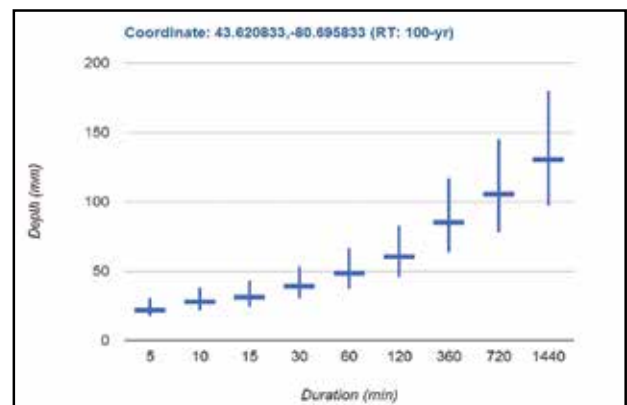


Figure 2: A sample IDF Curve showing confidence limits for a 100-year storm

The difference between the output IDF curves is different from the MSC station curves, but their overlap is generally within the 95 per cent confidence intervals.

Project location still forms the basis for the new IDF curves. Users can either enter coordinates for their project, or use Google maps interface embedded on the IDF tool website. Once the location is defined, or multiple locations in the case of large projects, the tool produces IDF curves with an error range. These new IDF curves ensure more reliable and precise representations of recent weather patterns. The curves can reflect changes in historic data and are updatable as new rainfall data becomes available. The interface tool is available through the MTO Website as well as on the Provincial Highway Management, Drainage and Hydrology Intranet page. [🔗](#)

Eric Soulis is an Associate Professor in the Department of Civil and Environmental Engineering.
uwaterloo.ca/civil-environmental-engineering/people-profiles/dr-eric-d-soulis

water institute news

GRADUATE STUDENT SCHOLARSHIPS

The Water Institute was pleased to announce that AECOM and Golder Associates scholarships will once again be offered to graduate students with water-focused research programs. These \$5,000 scholarships have been made available through generous contributions from Golder Associates since 2011/12 and AECOM since 2013/14. [▶](#)

COLLABORATIVE WATER PROGRAM

The new Collaborative Water Graduate Program was launched in the Winter 2014 term with an inaugural cohort of 25 students. This innovative program, jointly offered by eight departments, promotes the development of interdisciplinary perspectives on water. The inaugural cohort will be completing their second required course (WATER 602) during the Fall 2014 term, while the second cohort of students will take their first required course (WATER 601) in the Winter 2015 term. An information session for students and faculty interested in the program will be October 29th, 3:00-4:00 p.m. in DC 1302. [▶](#)

RBC VISITING FELLOW

The RBC Foundation is generously supporting the Collaborative Water Program, with funds being used to support student scholarships, visiting fellows and various program enrichment activities. The Water Institute is pleased to announce that Dr. Nigel Watson from Lancaster University will be on-campus as an RBC Visiting Fellow during November and December 2014. Nigel's research and teaching interests are in the area of natural resources governance and management, particularly water resources and the development of integrated approaches for catchments and entire river basin systems. While at Waterloo, Dr. Watson will participate in the Collaborative Water Program, meet students and faculty, and deliver a Water Institute seminar. [▶](#)

WATER INSTITUTE STRATEGIC PLAN 2014-2019

During 2013/14, the Water Institute developed a new five-year strategic plan that refreshed its vision and mission, and detailed goals and objectives in the priority areas of research, education and brand. A particular goal was to identify key research challenges, and to catalyze new activities to address the challenges. In upcoming months, the Institute will articulate its research challenges, and announce activities and programs to support research-related activities of its members and partners. [▶](#)



Dr. David Schinder delivers his lecture

WATER INSTITUTE PUBLIC LECTURE

On June 18, 2014, the Water Institute, together with the Faculty of Science, was pleased to host Dr. David Schindler who delivered a public lecture on "Canada's Freshwater in the 21st Century" to a full house in the Quantum Nanotechnology Building theatre. [▶](#)

water institute workshops

For the past several years, the Water Institute has supported workshops or small symposia to encourage new initiatives in interdisciplinary water research or education. Two workshops were held recently.

HEALTHY CLIMATES: GOVERNANCE IN THE WATER, ENERGY, FOOD AND CLIMATE SECURITY NEXUS

Coordinator: Larry Swatuk

On March, 24-25, 2014, a **Healthy Climates** workshop was held. The meeting, which was advertised and open to the public, brought together locally-based (Larry Swatuk, Bruce Frayne, Jennifer Clapp, Simon Dalby) and international scholars (Lapologang Magole, Stephen Otieno, Richard Matthew) to reflect on the theory and practice of resource governance within the discursive framework of a 'water, energy, food and climate security nexus'. The workshop also showcased the research of senior University of Waterloo PhD students working on various aspects of water, energy, food and climate security. Based around a mix of theory and practice, with the practice linked to case studies, the geographical focus of the workshop was global, with case studies from the Mackenzie River Basin and Great Lakes regions in Canada, to cities, rural farmlands, wetlands, parks and protected areas in Senegal, Kenya, Botswana, South Africa, China, the Middle East and North Africa. Two outputs are being expected to be produced from the workshop: (i) a monograph of edited papers; (ii) a follow-on research project. 🌊



Attendees at the Healthy Climates Workshop

HOW (WELL) ARE WE ADAPTING TO THE WATER-RELATED IMPACTS OF CLIMATE CHANGE?

Coordinators: Carrie Mitchell and Johanna Wandel

The workshop took place June 19-20, 2014, and was hosted by Waterloo's Interdisciplinary Centre on Climate Change (IC³) and funded by the Water Institute and the Balsillie School of International Affairs. The workshop was designed around three sessions with small group breakout discussions led by expert facilitators. There was a diverse representation of speakers and panel facilitators, totaling 20 individuals from five countries. The overall objective of the workshop was to develop a conceptual framework for assessing adaptation to the water related impacts of climate change. A comprehensive list of 'good' adaptation characteristics and components was identified through the workshop, with four key characteristics of 'good adaptation' emerging: fit, feasibility, flexibility, and framing. The workshop also provided an opportunity for guests to connect, and several project ideas and future event topics were identified. 🌊

WATER

students of the water institute

GRADUATE SECTION

SWIGS is launching a blog for graduate students to share their water related research and experiences. Do you have something you'd like to share? Your research journey? Experience from a recent conference? We are inviting guest writers to contribute to our blog. Check out the SWIGS website for more information: swigs.uwaterloo.ca

SWIGS members Arun Raj and Eduardo Cejudo contribute the first blog about their experience at the Wetskills Water Challenge held in July at Ryerson University.

WETSKILLS WATER CHALLENGE CANADA 2014

Wetskills water challenge is a Dutch water-related workshop created to facilitate interaction and exchange of ideas among Dutch and foreign students and young professional, and as a trigger to develop innovative solutions for existing water issues. It accommodates mixed, multidisciplinary teams who participate in a “battle of concepts with four basic criteria: innovativeness, technical feasibility, economic attractiveness and consideration of the social and environmental contexts”. Wetskills Canada was comprised of nine Dutch students and young professionals, two American students and nine Canadian students including the authors, Arun Raj and Eduardo Cejudo, from Waterloo.

After a period of team building water-themed field trips, we were introduced to the five case-studies: a decentralized WTP in Limonges, Ontario; improvement of grey- water and black-water for a new sub-division in Guelph; a real time mining effluents monitoring system in Saskatchewan; the reduction of phosphorous from urban non-point sources and an enhanced storm-water management strategy for Downtown Toronto. Arun participated in the development of real-time mining effluent monitoring and Eduardo participated in the



Wetskills Water Challenge Canada 2014 attendees

implementation of phosphorous reduction by means of green infrastructure. The teams were supported by 10 experts from a variety of disciplines and sectors, in addition to the case owners who were in close contact with teams throughout the process. Over seven days, intense group-working sessions produced a brief report, a poster and most importantly, a two-minute elevator pitch that would have to convince the jury that the idea fulfilled the requisites to be considered as the winner of the challenge. The winning team was the group self-named “*Water Holistics*”, with the proposal of a zero effluent decentralized solution for Guelph.

Wetskills was an enriching experience especially due to the close contact and collaboration with the mentoring companies (case-owners) working on real-life problems. It was a once-in-a-lifetime experience for us as it allowed us to interact with people from different academic and cultural backgrounds in a fast-paced working environment; yet, we still found time to enjoy evenings full of stories, experiences and fun. As one of the participants said, “...the City looked quite beautiful and at the moment I realized that Wetskills would be one of those experiences that I would remember for the rest of my life”.

The real-time mining effluent monitoring team that included Arun Raj was invited by their case owners, the Dutch based company INCAS3, to their head office in The Netherlands. The team presented their solution at the Canadian-Dutch SME business event hosted by INCAS3 in September 2014 and they are finalists in the Future Technologies for Water Competition managed by the Water Institute at the University of North Carolina at Chapel Hill. 

water institute external partners program

Platinum Level



RBC Foundation



Gold Level



UPCOMING EXTERNAL PARTNERS EMPLOYMENT FORUMS

Throughout November, Water Institute Employment Forums will be taking place. We are connecting our External Partners with UWaterloo Masters and PhD graduate students who focus on water research. The Water Institute is pleased to include this service as part of the membership benefits for Platinum and Gold Level External Partners.

External Partners will be making presentations about their organization's potential career opportunities. In addition, a panel discussion will expand on these opportunities, and will be followed by an exclusive networking session between our External Partners and graduate students. These forums will be held on campus at the Tatham Centre.

The Water Institute is partnering with the Students of the Water Institute, Graduate Section (SWIGS) and Cooperative Education and Career Action to host these Employment Forums. SWIGS members can submit resumes in advance of the forum and these will be made available online to our External Partners.

To participate in the External Partners Employment Forums or if you have other questions about the External Partners Program, please do not hesitate to contact Grant Murphy at g3murphy@uwaterloo.ca or at 519-888-4567, ext. 31883. You can also find more information about the External Partners Employment Forums at water.uwaterloo.ca/epp.

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