



**Mitchell Hall, Home of the Beaty Water Research Centre
Queen's University, 69 Union Street West, Kingston, ON**



TABLE OF CONTENTS



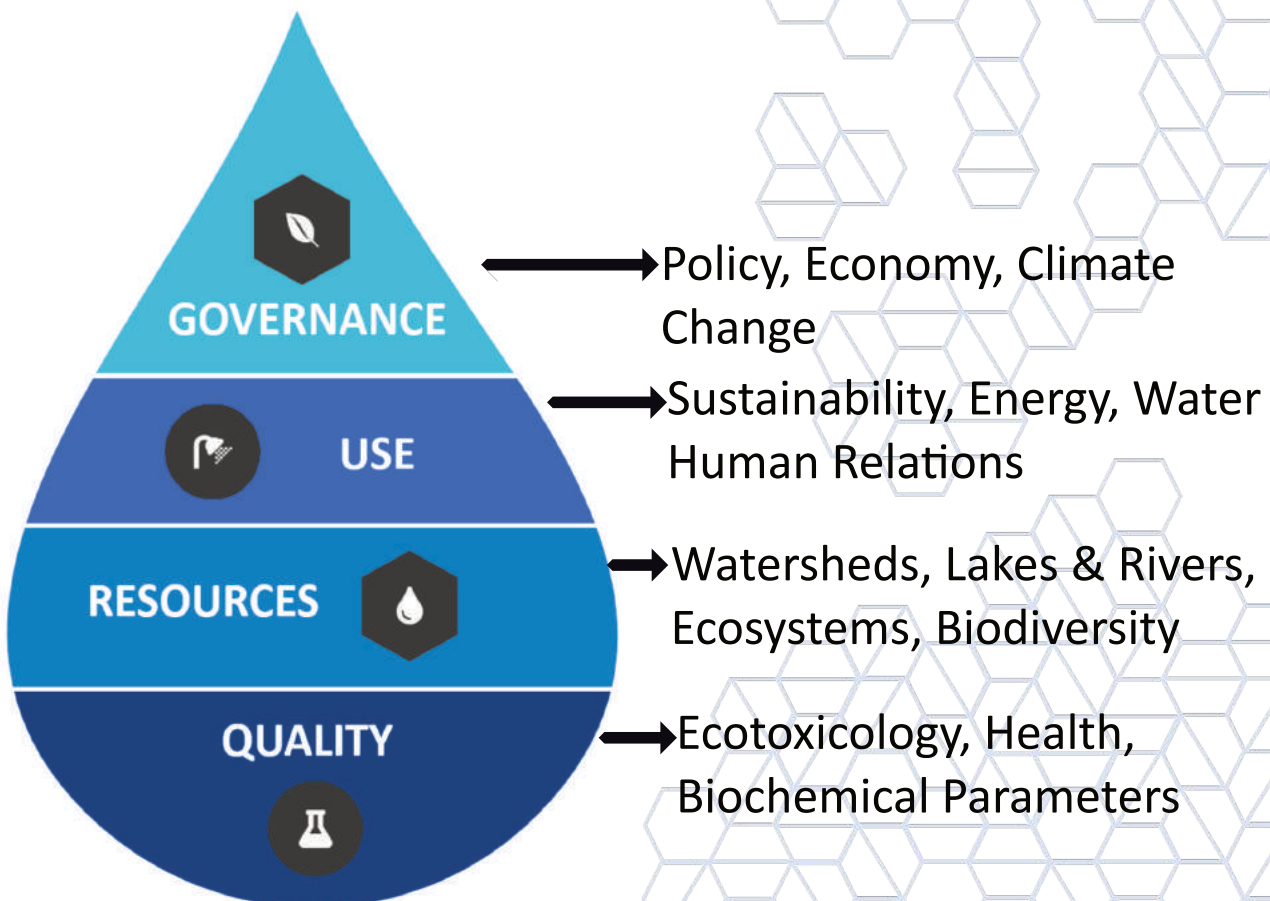
1	Our Vision and Mission
2	Overview
3	Message from the Director
4	BWRC by the Numbers
5	Advisory Board
6	Research Facilities
7	Activity Highlights
8	Research
10	Education
12	Outreach
13	Knowledge Translation
15	Outcomes
16	BWRC Administration
17	BWRC Associated Faculty
20	Research Projects
23	Faculty Publications 2018-2019
27	Financial Statements

VISION

To work collaboratively with the community, researchers, industry, policy makers and educators to inform, educate and advocate for the development of innovative tools, programs and policy related to the protection and improvement of water governance, quality, use, resources and sustainability.

MISSION

The Beaty Water Research Centre (BWRC) is an interdisciplinary Centre dedicated to furthering research, education and outreach on water-related issues. The Centre's mission is to encourage collaborative research, innovation and education spanning traditional water related disciplines, as well as non-traditional and emerging disciplines. Our interdisciplinary model facilitates the easy transition of new knowledge and innovation into practice. Activities of the Centre fall into the following themes:



OVERVIEW

The Beaty Water Research Centre (BWRC) is an interdisciplinary research and education Centre at Queen's University. We welcome collaborations with researchers, educators, policy makers, industry and the community on activities related to water access, resources, quality and use. Our research faculty are leaders in engineering, chemistry, biology, geology, geography & planning, health, computing & data analytics, business, law and policy.

As part of the Centre's education and outreach mandate, we develop strong partnerships with academic departments, industry, school boards, public health units and local water conservation authorities. Through these partnerships we offer educational opportunities and internships across disciplines for students, the public and professionals. In Fall 2019, the BWRC will launch the first of many accredited online diploma programs. Courses offered through the BWRC bridge the gap between disciplines, theory and real-world applications for all students, providing graduates with a competitive edge in their chosen career field.



Mitchell Hall, Home of the Beaty Water Research Centre

MESSAGE FROM THE DIRECTOR

The Centre's research faculty come from disciplines across the Faculties of Engineering & Applied Science, Arts & Science and Health Sciences at Queen's and partner institutions, such as the Royal Military College (RMC). We conduct research on all issues related to water and offer a range of interdisciplinary training opportunities to undergraduate, graduate and post graduate students through our online graduate diploma programs and tailored workshops. Students across campus can participate in our workshops offered in collaboration with graduate programs at the Master's and PhD level at Queen's University.



Dr. Pascale Champagne, Ph.D., P.Eng., D.WRE, F.EWRI, F.ASCE
Director, Beaty Water Research Centre
Queen's University

This has been a busy and successful year for BWRC. In December 2018, we moved into our new state-of-the-art facilities in Mitchell Hall, made possible by a generous gift from the Beaty Family. We received approval for our first graduate diploma program and have begun work on the development of national interdisciplinary research networks focused on various issues related to water. In this annual report we will highlight some major activities in each of our three pillars - **research**, **education** and **outreach**.

We hope you enjoy reading this year's report, and we look forward to engaging with you in the year ahead. If you would like to hear more about our work or would like to collaborate feel free to contact us.

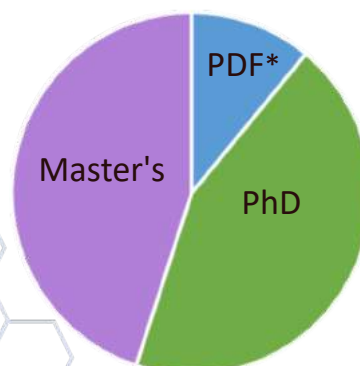
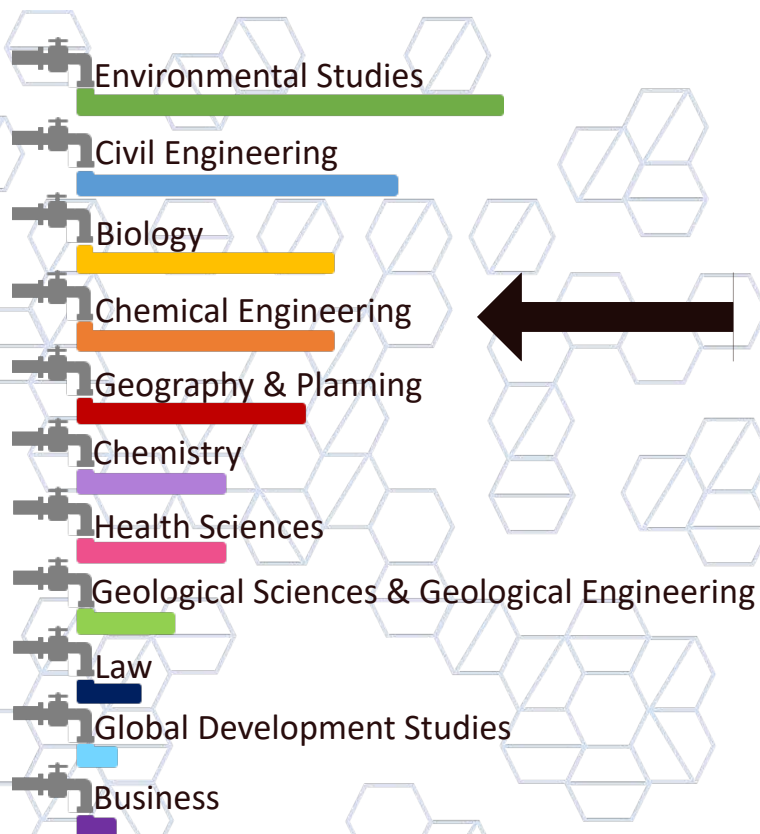
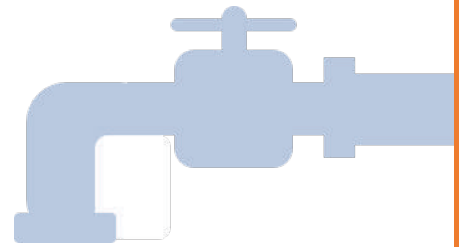
BWRC BY THE NUMBERS

69 Publications and Conference Presentations

32 Research Projects

5 Lectures/Seminars

2 Conferences



*Postdoctoral Fellows

ADVISORY BOARD

The Centre is governed by an Advisory Board. This board was established in 2018 and its members provide representation from Queen's Faculty of Engineering & Applied Science, Faculty of Arts & Science, Faculty of Health Sciences, industry and community organization members.



Chair
David Carnegie
Industry Partner,
Malroz
Engineering Inc.



**Pascale
Champagne**
Director BWRC



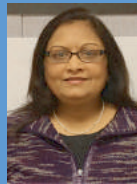
Holly Evans
Community Partner
Cataraqui Region
Conservation
Authorities



Amir Fam
Associate Dean
(Research), Faculty
of Engineering &
Applied Science



Geof Hall
Associate Director
BWRC, Education
& Outreach



Jyoti Kotecha
Associate Director
BWRC, Research &
Business
Development



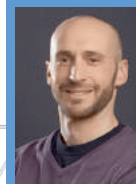
**Anastasia
Lintner**
Community
Partner, Lintner
Law



Nicholas Mosey
Associate Dean
(Research), Faculty
of Arts & Science



**Kent
Novakowski**
Associate Vice
Principal (Research)



Steven Smith
Director of
Research, Faculty
of Health Sciences

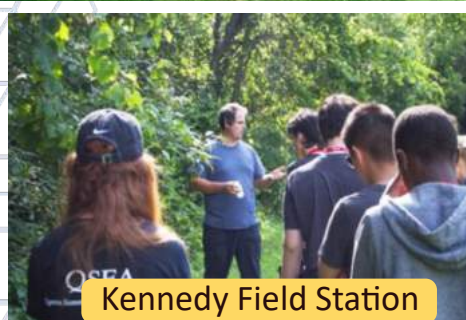
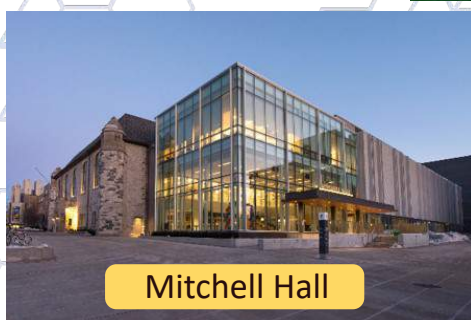
RESEARCH FACILITIES

The Centre is located in a new state-of-the-art facility in Mitchell Hall at Queen's University in Kingston, Ontario. The Centre also has a strategic network of affiliated field facilities which include:

- *Queen's Coastal Engineering Lab
- *Queen's Biological Station
- *Kennedy Field Station
- *Tay River Groundwater Network
- *Loyalist Township Constructed Wetland

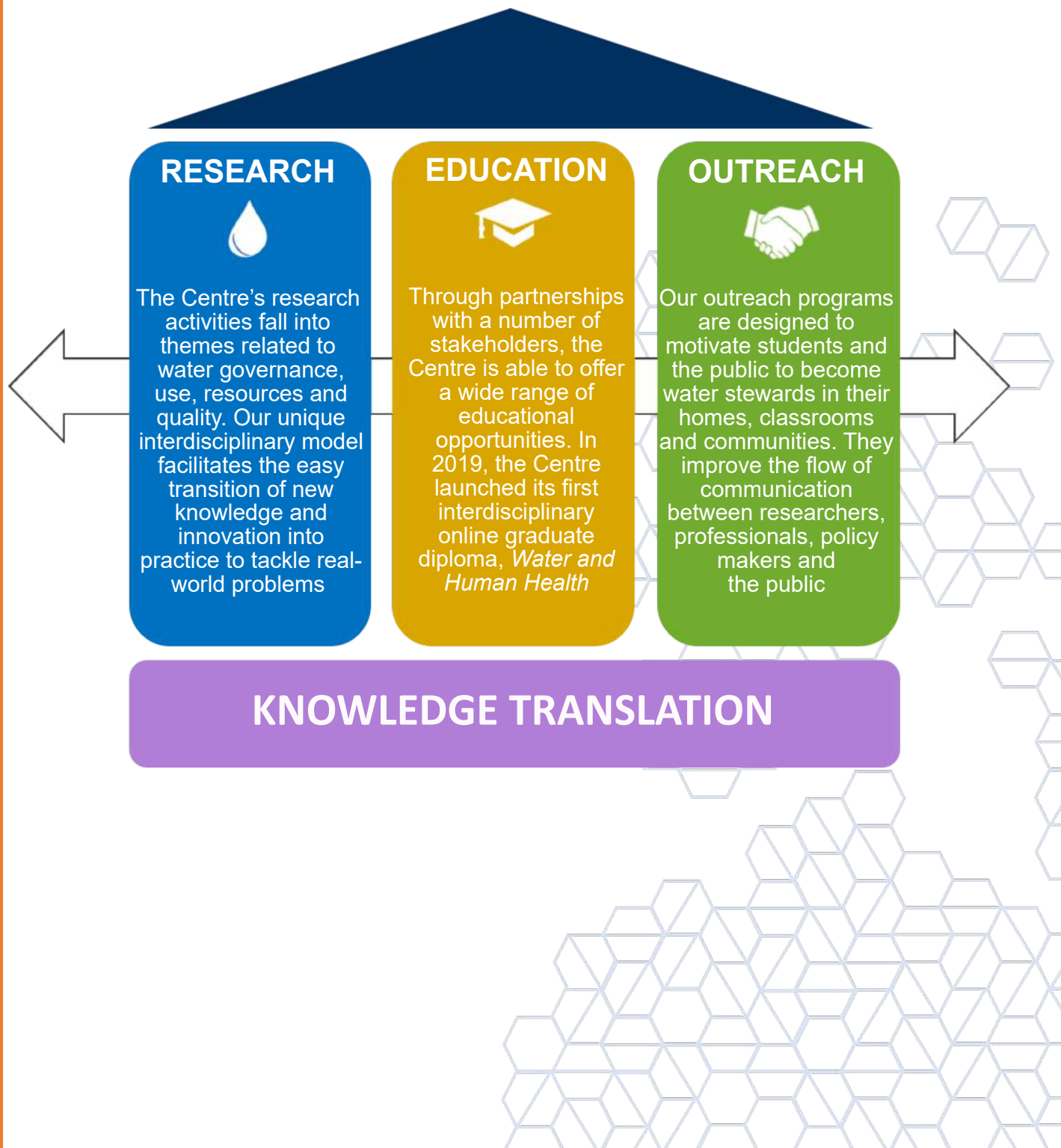


In 2019, the Centre will also be adding the [Cape Bounty Arctic Watershed Observatory \(CBAWO\)](#) as a field facility. These facilities allow us to create pilot studies by moving and testing bench scale research in the field.



ACTIVITY HIGHLIGHTS

The Centre has three pillars of focus; research, education and outreach.



RESEARCH

This year we expanded collaborations with faculty from various disciplines at Queen's, the Royal Military College of Canada and external academic intuitions at the national and international level. Our research links to industry and non-profit organizations such as conservation authorities, school boards and the public health authority. This year's highlights include:

Launch of the LEaders in wAter and wAtERshed Sustainability (LEADERS) program, lead by Dr. Stephen Brown, Associate Professor in the Department of Chemistry & Environmental Studies. LEADERS is funded (\$1.65M over six years) through the NSERC Collaborative Research and Training Experience (CREATE) initiative.



Development of collaborations with the Cape Bounty Arctic Watershed Observatory (CBAWO) at Queen's, which will become a BWRC affiliated field research facility in 2019.



Received Mitacs Career Connect funding (\$60,500) to support three STEM post-graduate internships to address the research and development needs of our community partners, Quinte Conservation and Loyalist Township. This initiative ties together research, education and outreach pillars of the Centre.



RESEARCH



Ontario Centres of Excellence



**NSERC
CRSNG**

Received Ontario Centre of Excellence Voucher for Innovation and Productivity I (VIP I) program funding (\$25,000) and NSERC Engage program funding (\$20,000) to assess the use of microbially-induced calcite precipitation (MICP) to improve the deposit performance of tailings.



International Water Decade Alliance

WATER FOR SUSTAINABLE DEVELOPMENT (2018-2028)

Expansion of our national research networks by becoming a member of the International Water Decade Alliance (2018-2028).

WDSA / CCWI 2018

Water Distribution Systems Analysis

Computing and Control for the Water Industry

KINGSTON, CANADA

23-27 July 2018



Leading and hosting the first International Joint Conference in Water Distribution Systems Analysis & Computing and Control in the Water Industry conferences. The conference was lead by Dr. Yves Filion and Dr. Michael Hulley and attracted over 50 abstract submissions.



Faculty affiliated with the Centre led 32 research projects that aligned to activities addressing the mandate of the Centre (see pages 20-22).



Knowledge translation is a focus. This year, the Centre's affiliated research generated approximately 69 peer-reviewed publications (See Pages 23-26).

EDUCATION

Through partnerships with a number of stakeholders, the Centre is able to offer a wide range of educational opportunities. This year we focused on the creation of our first online graduate diploma program in Water and Human Health (WHH). The program will launch in the Fall of 2019.

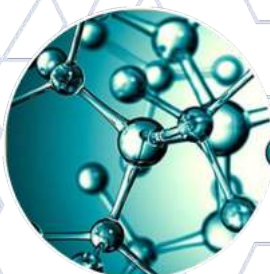
This diploma program is designed to give recent graduates and professionals an enhanced understanding of the role water plays in driving health outcomes and ultimately, the sustainability of populations and communities.

The diploma prepares students for a career in a variety of industries and organizations. This includes working in the public health sector, engineering & environmental consulting, conservation authorities, non-profit organizations and government planning & management.

COURSES



Watershed
Hydrology



Chemistry &
Biology of Natural
Waters



Water Policy &
Governance



Water &
Human Health

**Water and
Human Health G.Dip**
Applying to and Navigating Graduate Studies



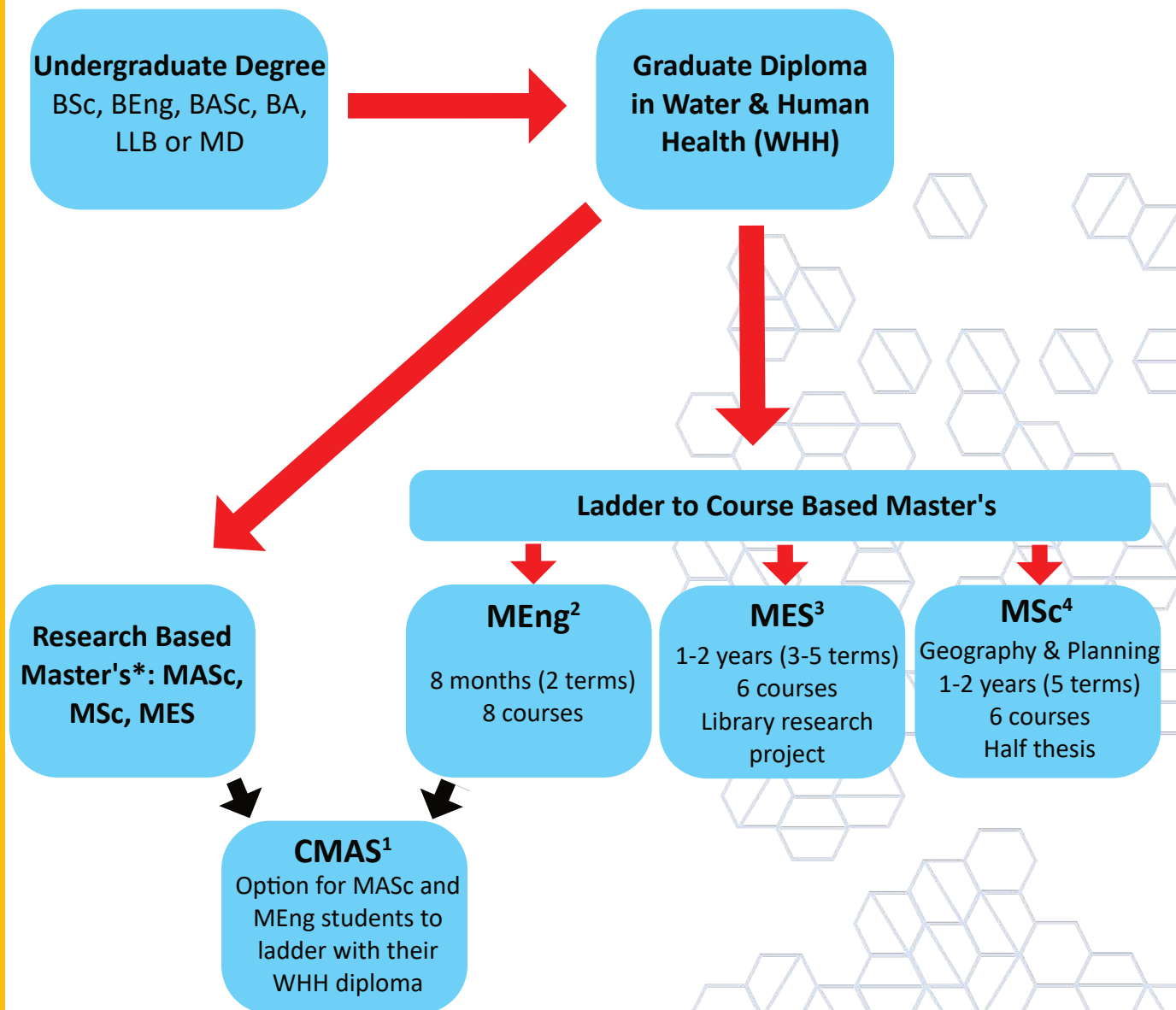
Why a **GRADUATE DIPLOMA** in **WATER AND HUMAN HEALTH**?

The Graduate Diploma in Water and Human Health, hosted by the Beatty Water Research Centre (BWRC), is designed to give recent graduates and professionals an enhanced understanding of the role of water in driving health outcomes and ultimately the sustainability of populations and communities. This diploma will investigate water in its natural state with an emphasis on the chemical and biological contaminants on human health. The movement of water throughout watersheds will be explored to give students an understanding of hydrological processes, while water regulations and policy will be discussed within the context of driving governance issues in many jurisdictions.



EDUCATION

Although the program is a stand alone offering, graduates may ladder the 4 course credits they receive into two types of Master's degrees at Queen's; 1) Research Based and 2) Course Based. The laddering pathway of the diploma programs will also support recruitment of highly skilled graduate students to the Faculties of Engineering & Applied Science and Arts & Science.



*To obtain a MASc or MSc with a research thesis component, students may be granted advanced standing for one or more courses completed in the Graduate Diploma

1 Collaborative Master's Program in Applied Sustainability: <https://my.engineering.queensu.ca/programs/mas/>

2 <https://engineering.queensu.ca/future-students/graduate/why-meng/>

3 <https://www.queensu.ca/ensc/graduate/mes-program-guide>

4 <https://www.queensu.ca/geographyandplanning/mamscphd/graduate-programs>

OUTREACH

The BWRC hosted the annual Great Lake Water Festival in collaboration with school boards, the health unit and conservation authorities. This was held at Lake Ontario park in Kingston, Ontario. Supported by Queen's graduate students, over 300 local Grade 4 students and their teachers participated in curriculum-based activities designed to instill the values of water and watersheds. The Centre also supported the EngAGE Engineering Summer Academy, which highlights fun and interesting elements of pursuing studies in engineering to high school students.



CATARAQUI CONSERVATION
FOUNDATION



Utilities
Kingston



**sustainable
kingston**



RBC

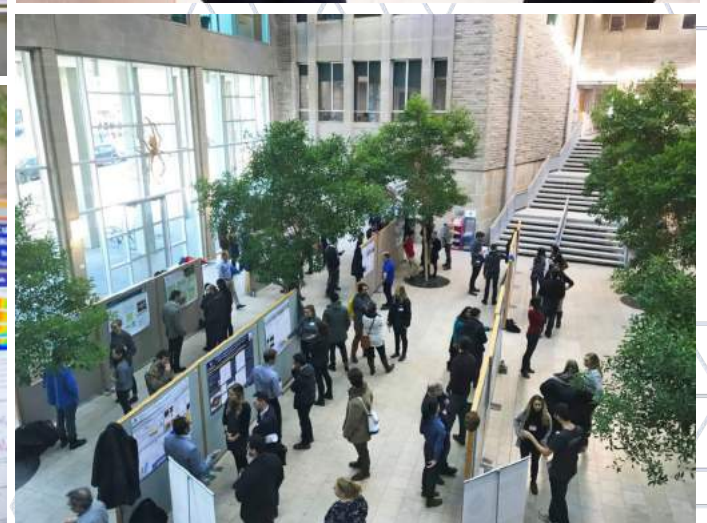
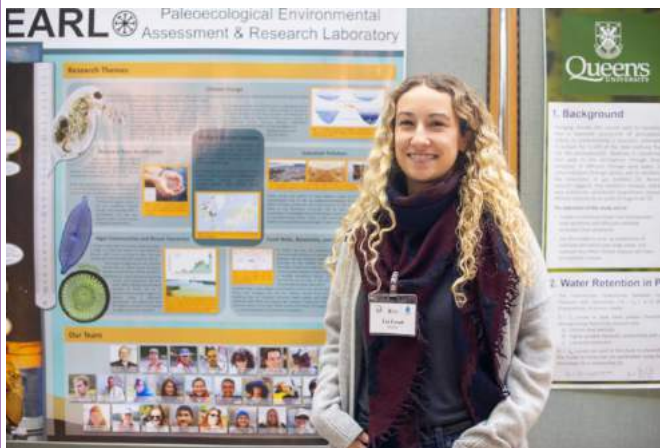


KFL&A
Public Health



KNOWLEDGE TRANSLATION

The BWRC engages in a number of Knowledge Translation activities. This year these activities included the first annual BWRC and LEADERS Research Symposium. This symposium was established to improve the flow of communication and ideas by bringing together researchers from Queen's University and the Royal Military College of Canada (RMC), who are often separated by disciplines or institutions.



KNOWLEDGE TRANSLATION

BWRC Affiliated Faculty, Dr. Yves Fillion and Dr. Michael Hulley, hosted the 1st International Water System Distribution Analysis (WDSA) and Computing and Control for the Water Industry (CCWI) Conference at Queen's University in July 2018. This conference brought together professionals and researchers from around the world to solve problems in the field of urban water systems, modelling and control.



For the first time in Winter 2019, the BWRC and LEADERS program jointly hosted a Winter/Spring Seminar Series. This series brought in a wide range of National and International Professionals in Academia, Government and Industry to speak on various water related topics to our faculty and students.

The Beaty Water Research Centre & LEADERS Program

Seminar Series 2019

Seminars generally take place from 2:30-3:30pm in the LinQ Lab of the Dunin-Deshpande Innovation Centre (Rm. 106), first floor of Mitchell Hall. Light refreshments are provided!

Winter/Spring Series Schedule

March 20th- Dr. Joe Manous, Director of the Institute for Water Resources with the US Army Corp of Engineers

April 17th- Dr. Christine Dow, Assistant Professor, Faculty of Environment University of Waterloo

April 25th- Dr. Elodie Passeport, Assistant Professor, University of Toronto

May 8th- Dr. Leigh McGaughey, Project Scientist, St. Lawrence River Institute of Environmental Sciences

June 19th- Dr. Lei Liu, Water Program Lead, Imperial Oil



www.waterresearchcentre.ca/ [@BeatyCentre](https://twitter.com/BeatyCentre) [beatywaterresearchcentre](https://www.instagram.com/beatywaterresearchcentre)



OUTCOMES

RESEARCH



Enhanced Water Quality & Access

Interdisciplinary collaborations leading to development of methods and innovation to improve water access and quality



Innovation in Water Treatment Systems

New technologies developed leading to improved water treatment systems and biosustainability



Sustainable Infrastructure Implemented

Natural and built Infrastructure improvements implemented in response to climate change



Influence Environmental Policy & Law

Policies and innovations developed and implemented to improve water governance, use, resources and quality



Through interdisciplinary collaborations, research knowledge is easily translated into action through implementation of innovation and policy development

EDUCATION



Interdisciplinary

Graduate Diploma Programs offers courses that span multiple disciplines, providing students an advantage in today's workforce



Synergy & Collaboration

Cross-disciplinary collaborations in the delivery of programs providing learning opportunities that allow application of knowledge broadly



Networking Opportunities

Our programs allow students to network with a wide variety of stakeholders, providing them with a kick start to their career



Skill Building & Future Workforce

Our programs help students build practical & professional skills to prepare them to become capable STEM employees



We train our students to effectively translate knowledge from research findings to a broad audience

OUTREACH



Inform & Empower

Informing and empowering the community leading to changing behavior related to water quality and sustainability



Engagement for Collaborative Change

Informing and educating motivates students and the public to become water stewards in their homes, classrooms and communities



Align Activities with Knowledge Gaps

Stakeholder consultations leading to alignment of activities with knowledge gaps



Change Implemented

Implement knowledge and innovation working with conservation authorities, industry, health units and municipal, provincial and federal government



Our outreach events improve the flow of communication between researchers, professionals, policy makers and the public to influence and implement change

KNOWLEDGE TRANSLATION

BWRC ADMINISTRATION



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Civil Engineering



Shelley Arnott
Professor, Biology



Leon Boegman
Associate Professor,
Civil Engineering



Richard Brachman
Professor, Civil
Engineering



Stephen Brown
Associate Professor,
Chemistry



John Casselman
Adjunct Professor,
Biology



Pascale Champagne
Professor, Civil
Engineering



Dongmei Chen
Professor, Geography
& Planning



Brian Cumming
Professor, Biology



Michael Cunningham
Professor, Chemical
Engineering



Ana Maria da Silva
Professor, Civil
Engineering



Ryan Danby
Associate Professor,
Environmental Studies



Aris Docoslis
Professor, Chemical
Engineering



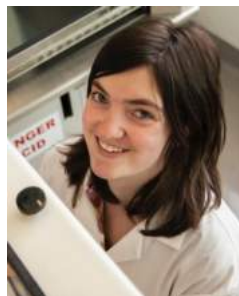
Carlos Escobedo
Assistant Professor,
Chemical Engineering



Gerald Evans
Professor, Biomedical
& Molecular Sciences



Yves Filion
Professor, Civil
Engineering



Anna Harrison
Assistant Professor,
Geological Science &
Engineering



Peter Hodson
Professor Emeritus,
Environmental Studies



Michael Hulley
Associate Professor,
Civil Engineering (RMC)



Heather Jamieson
Professor, Geological
Science & Engineering

BWRC ASSOCIATED FACULTY



Philip Jessop
Professor, Chemistry



Bernard Kueper
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Melissa Lafrenière
Associate Professor,
Geography & Planning



Scott Lamoureux
Professor, Geography
& Planning



Dan Lefebvre
Professor, Biology



Anastasia Lintner
Adjunct Professor,
Law



Steven Liss
Professor,
Environmental Studies



Hans-Peter Look
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Steve Lougheed
Professor, Biology



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Civil Engineering



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Kent Novakowski
Professor, Civil
Engineering

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Assistant Professor,
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Bruce Pardy
Professor, Law



Ugo Piomelli
Professor, Mechanical
& Materials Engineering



Juliana Ramsay
Professor, Chemical
Engineering



Victoria Remenda
Associate Professor,
Geological Science &
Engineering



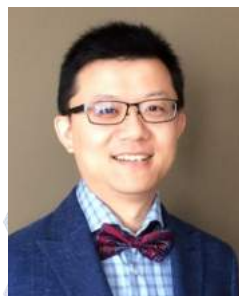
Mark Rosenberg
Professor, Geography
& Planning



Kerry Rowe
Professor, Civil
Engineering



Neal Scott
Associate Professor,
Geography & Planning



Zhe She
Assistant Professor,
Chemistry



John Smol
Professor, Biology



Bruce Tufts
Professor, Biology



Yuxiang Wang
Associate Professor,
Biology



Kela Weber
Associate Professor,
Chemical Engineering
(RMC)



Graham Whitelaw
Associate Professor,
Environmental Studies



Louise Winn
Professor, Biomedical
& Molecular Sciences



Barb Zeeb
Professor, Chemical
Engineering (RMC)

RESEARCH PROJECTS

Project	BWRC Faculty Lead	Funding	Organization
LEaders in wAtEr andD watERshed Sustainability (The LEADERS Project)	Stephen Brown	\$1,650,000 over 6 years	NSERC CREATE
Persistent, Emerging, and Oil Pollution in cold marine Environments (PEOPLE CREATE training program)	Pascale Champagne – Queen's University Lead Bing Chen – Program Lead, Memorial University	\$1,650,000 over 6 years	NSERC CREATE
Contamination of river beds by oil spills and impact on fish habitats	Stephen Brown	\$453,000	NSERC SPG
Development of new tests for bacteria in water	Stephen Brown	\$200,000	TECTA-PDS Inc.
Development of new tests for bacteria in water	Stephen Brown	\$194,950	Southern Ontario Water Consortium AWT Program
Detection of intact pathogenic bacteria using nanoplasmonic sensors	Carlos Escobedo	\$125,000 over 5 years	NSERC
Environmental fate of a hydrolytically degradable cationic flocculant to remediate oil sands mature mine tailings	Louise Meunier	\$130,000 \$100,000	NSERC Discovery Queen's SGS PhD Award
Developing a Framework for the Reliability Analysis of Water Distribution Systems	Yves Filion	\$215,000	NSERC Discovery
Hydrodynamics of Wastewater Stabilization Ponds	Yves Filion	\$81,000	Dean's Research Fund, FEAS, Queen's University
Managing storm water quality in the Town of Jasper	Yves Filion	\$215,000	NSERC Discovery
The Canadian Lyme Disease Research Network	Kieran Moore	\$4 million over 4 years	CIHR Team Grant
The WELLness Project	Anna Majury	\$25,000	Canadian Foundation of Infectious Diseases
Environmental <i>E. coli</i> and the opportunity to ARO reservoirs	Anna Majury	\$10,000	Canadian Foundation of Infectious Diseases

RESEARCH PROJECTS

Project	BWRC Faculty Lead	Funding	Organization
Methods and uncertainty modeling for land cover change detection from multi-resolution remotely sensed data	Dongmei Chen	\$31,000 per year	NSERC DISCOVERY
CO ₂ -Triggered Draw Agents for Forward Osmosis	Philip Jessop, Michael Cunningham, Pascale Champagne	\$552,740	NSERC SPG
Triphenyl phosphate and ecosystem toxicity	Louise Winn	\$28,000 for 5 years	NSERC
Impacts of stray gas migration on shallow groundwater: Insights from laboratory experiments and numerical modelling	Kevin Mumford	\$537,475	NSERC SPG
Soil remediation using in-situ thermal treatment	Kevin Mumford	\$250,000	MRI OCRIF
The role of gases in groundwater contamination and remediation	Kevin Mumford	\$135,000	NSERC DG
Collaborative research: Towards a mechanistic prediction of methane ebullition fluxes from northern peatlands	Kevin Mumford	\$219,640	NSF
Remediation education network	Kevin Mumford and Kent Novakowski - Queen's Leads Brent Sleep - Program Lead, University of Toronto	\$1,650,000 over 6 years	NSERC CREATE
Remunicipalization: The Future of Water Services	David McDonald	\$185,000	SSHRC
Public Water / Public Banks	David McDonald	\$20,000	SSHRC
Feasibility for 'Real Time' Quantification of Wastewater Bacteriological Composition	Pascale Champagne	\$25,000	NSERC ENGAGE TECTA-PDS
Analysis & Prediction of Legacy & Emerging Contaminant Discharge & Mixing in the Great Lakes Receiving Environment	Pascale Champagne	\$81,000	Dean's Research Fund, FEAS, Queen's University
The Development of CO ₂ -Switchable Polymers as Draw Solutes for Forward Osmosis	Pascale Champagne	\$20,000	Mitacs Accelerate Forward Water
Fairfield Water System Process Review	Pascale Champagne	\$20,500	Mitacs Career Connect, Loyalist Township

RESEARCH PROJECTS

Project	BWRC Faculty Lead	Funding	Organization
Water Management Program and Process Reviews – Salmon River Project	Pascale Champagne	\$20,500	Mitacs Career Connect, Quinte Conservation Authorities
Biogeocementation-Biologically Catalyzed Reactions to Create Rock-Like Tailing Deposits	Pascale Champagne	\$25,000 \$20,000	OCE VIP I NSERC ENGAGE BGC
Fate and effects of metallic nanoparticles in wetland systems	Kela Weber	\$215,000 over 5 years	NSERC Discovery
Field Testing of Novel Technologies for Restoring Challenging Contaminated Sites	Kela Weber	\$99,000 over 3 years	NSERC CRD
Remediation of Soil and Groundwater Impacted by Per- and Polyfluoroalkyl Substances	Kela Weber	\$70,000 over 3 years	NSERC CRD



**NSERC
CRSNG**



SOUTHERN ONTARIO WATER CONSORTIUM
LE CONSORTIUM POUR L'EAU
DU SUD DE L'ONTARIO



Canadian Foundation
for Infectious Diseases
Fondation canadienne
des maladies infectieuses



Queens
UNIVERSITY

FACULTY OF
ENGINEERING AND
APPLIED SCIENCE

TECTA - PDS



Mitacs



**Ontario Centres of
Excellence**

SSHRC CRSH
Social Sciences and Humanities Research Council of Canada
Conseil de recherches en sciences humaines du Canada



FACULTY PUBLICATIONS 2018-2019

- 1 Azan SSE, Yan ND, Celis M, Arnott SE, Risak JA, Sutey P. (Mar 2019) Could a residential wood ash recycling programme be part of the solution to calcium decline in lakes and forests in Muskoka (Ontario, Canada)? *FACETS* 4: 69-90
- 2 Barouillet C, Cumming B, Laird KR, Perrin CJ, Selbie DT. (Mar 2019) Influence of glacial flour on the primary and secondary production of Sockeye Salmon nursery lakes: a comparative modern and paleolimnological study. *Can J Fish Aquat Sci*, <https://doi.org/10.1139/cjfas-2018-0372>
- 3 Beel C, Lamoureux SF, Orwin JF. (Oct 2018) Fluvial Response to a Period of Hydrometeorological Change and Landscape Disturbance in the Canadian High Arctic. *Geophys Res Lett*, 45(19):10,446-10,455
- 4 Binns AD, Fata A, da Silva AMF, Bonakdari H, Gharabaghi B. (Apr 2019) Modeling Performance of Sediment Control Wet Ponds at Two Construction Sites in Ontario, Canada. *J Hydraul Eng*, 145(4):05019001: 1-12
- 5 Boegman L, Stastna M. (Jan 2019) Sediment Resuspension and Transport by Internal Solitary Waves. *Annu Rev Fluid Mech*, 51(1): 129-154
- 6 Bullard GK, Mulligan RP, Take WA. (Jan 2019) An Enhanced Framework to Quantify the Shape of Impulse Waves Using Asymmetry. *J Geophys Res-Oceans*, 124(1): 652-666
- 7 Button M, Cosway K, Sui J, Weber KP. (Feb 2019) Impacts and fate of triclosan and sulfamethoxazole in intensified re-circulating vertical flow constructed wetlands. *Sci Total Environ*, 649: 1017-1028
- 8 Cabrerizo A, Muir DCG, De Silva AO, Wang X, Lamoureux SF, Lafrenière MJ. (Dec 2018) Legacy and Emerging Persistent Organic Pollutants (POPs) in Terrestrial Compartments in the High Arctic: Sorption and Secondary Sources. *Environ Sci Technol*, 52(24): 14187-14197
- 9 Champagne P, Kumar P, Hall G, Cuprys A, Liang S, Taheran M, Blair D, Naghdi M, McKellar M and Brar S. (2018) Water Quality in Canada in Water Quality in the Americas IANAS-Water Group
- 10 Coch C, Lamoureux SF, Knoblauch C, Eischeid I, Fritz M, Obu J, Lantuit H. (Aug 2018) Summer rainfall DOC, solute and sediment fluxes in a small Arctic coastal catchment on Herschel Island (Yukon Territory, Canada). *Arct Sci*, 4(4): 750-780
- 11 Coch C, Juhls B, Lamoureux SF, Lafrenière MJ, Fritz M, Heim B, Lantuit H. (Jan 2019) Characterizing organic matter composition in small Low and High Arctic catchments using terrestrial colored dissolved organic matter (cDOM) *Biogeosciences Discuss*, <https://doi.org/10.5194/bg-2019-9>
- 12 Collotta M, Champagne P, Mabee W, Tomasoni G, Alberti M. (Dec 2018) Life Cycle Analysis of the Production of Biodiesel from Microalgae: The Italian Experience *Green Energy and Technology*, In book: Life Cycle Assessment of Energy Systems and Sustainable Energy Technologies
- 13 Di Pelino S, Schuster-Wallace C, Hynds PD, Dickson-Anderson SE, Majury A. (Mar 2019) A coupled-systems framework for reducing health risks associated with private drinking water wells. *Can Water Resour J*, 44(3): 280-290
- 14 Fatehi-Pouladi S, Anderson BC, Wootton BC, Button M, Bissegger S, Rozema L, Weber KP. (Oct 2018) Interstitial water microbial communities as an indicator of microbial denitrifying capacity in wood-chip bioreactors. *Sci Total Environ*, 655: 720-729
- 15 Feng Y, Chen D, Ouyang X, Zhang X. (Jul 2018) Variability of satellite-based total aerosols and the relationship with emission, meteorology and landscape in North China during 2000–2016. *Environ Earth Sci*, 77(13): 499
- 16 Feng Y, Chen D, Zhao X. (Aug 2018) Estimated long-term variability of direct and diffuse solar radiation in North China during 1959–2016. *Theor Appl Climatol*, 137(1-2): 153-163
- 17 Fruetel C, Mumford K, da Silva AMF, Rey A, Bascom KS. (Nov 2018) A laboratory method for the visualization and quantification of hyporheic flow paths and velocities. *Can J Civil Eng*, 46(5): 448-457
- 18 Gagnon V, Button M, Boparai HK, Nearing MM, O'Carroll DM, Weber KP. (Nov 2018) Influence of realistic wearing on the morphology and release of silver nanomaterials from textiles. *Environ Sci Nano*, 6(2): 411-424
- 19 Gan C, Hall G, Champagne P. (Jun 2018) Pilot-Scale Evaluation of Semi-Passive Treatment Technologies for the Treatment of Septage Under Temperate Climate Conditions. *J Environ Manage*, 216:357-371
- 20 Glasing J, Jessop P, Champagne P, Cunningham M. (May 2018) Graft-Modified Cellulose Nanocrystals as CO₂-Switchable Pickering Emulsifiers. *Poly Chem UK*, 9(28):3864-3872 (July 2018 Best Paper Award; Featured issue cover)
- 21 Grewer DM, Lafrenière MJ, Lamoureux SF, Simpson MJ. (Jun 2018) Spatial and temporal shifts in fluvial sedimentary organic matter composition from a High Arctic watershed impacted by localized slope disturbances. *Org Geochem*, 123: 113-125

FACULTY PUBLICATIONS 2018-2019

- 22 Harris J, Viner K, Champagne P, Jessop P. (Aug 2018) Advances in Microalgal Lipid Extraction for Biofuel Production: A Review. *Biofuel Bioprod Bior*, 12(6):1118-1135
- 23 Hicknell BN, Mumford KG, Kueper BH. (Dec 2018), Laboratory study of creosote removal from sand at elevated temperatures, *J Contam Hydrol*, 219: 40-49
- 24 Hodgkins LM, Mulligan RP, Mccallum J, Weber KP. (Mar 2019) Modelling the transport of shipborne per- and polyfluoroalkyl substances (PFAS) in the coastal environment. *Sci Total Environ*, 658: 602-613
- 25 Hoffman T, Hynds PD, Wallace C, Dickson-Anderson SE, Majury A. (Feb 2019) Harnessing smart technology for private well risk assessment and communication. *Water Security*, 6: 100026
- 26 Hudson-Edwards KA, Byre P, Bird G, Brewer P, Burke IT, Jamieson H, Macklin MG, Williams RD. (Mar 2019) Origin and Fate of Vanadium in the Hazeltine Creek Catchment following the 2014 Mount Polley Mine Tailings Spill in British Columbia. *Environ Sci Technol*, 53(8): 4088-4098
- 27 Husk B, Sanchez JS, Anderson BC, Whalen JK, Wootton BC. (May 2018) Removal of phosphorus from agricultural subsurface drainage water with woodchip and mixed-media bioreactors. *J Soil Water Conserv*, 73(3): 265-275
- 28 Jabbari A, Boegman L, Mackay MD. (Jun 2018) Future prediction of hypolimnetic dissolved oxygen concentrations in small lakes. Conference: 5th IAHR Europe Congress At: Trento, Italy
- 29 Jaoude IB, Novakowski K, Kueper B. (Sep 2018) Identifying and assessing key parameters controlling heat transport in discrete rock fractures. *Geothermics*, 75:93-104
- 30 Lafrenière MJ, Lamoureux SF. (Jan 2019) Effects of changing permafrost conditions on hydrological processes and fluvial fluxes. *Earth-Sci Rev*, 191: 212-223
- 31 Latchmore T, Wallace C, Longboat DR, Dickson-Anderson, SE, Majury A. (Dec 2018) Critical elements for local Indigenous water security in Canada: A narrative review. *J Water Health*, 16(6): 893-903
- 32 Liang S, Champagne P, Hall G. (Oct 2018) Monitoring Long-term Trends and Seasonal Variations in Treatment Performance of a Small Wastewater Treatment System with Algal Blooms. Conference: IWA SWWS2018 15th Conference on Small Water & Wastewater Systems and 7th Conference on Resources Oriented Sanitation At: Haifa, Israel
- 33 Liang S, Champagne P, Hall G. (Oct 2018) Examining the Effect of Water Chemistry and Climatic Factors on Algal Bloom Dynamics in a Decentralized Wastewater Treatment System. Conference: IWA SWWS 2018 15th Conference on Small Water & Wastewater Systems and 7th Conference on Resources Oriented Sanitation At: Haifa, Israel
- 34 Liang S, Champagne P, Hall G. (Sep 2018) Water Chemistry and Climatic Factors Affecting Seasonal Algal Dynamics in a Wastewater Stabilization Pond. Conference: IWA Specialist Conference on Wetland Systems for Pollution Control At: Valencia, Spain
- 35 Liu L, Champagne P, Hall G. (Oct 2018) The Role of Algae in the Removal and Inactivation of Pathogenic Indicator Organisms in Wastewater Stabilization Pond Systems Conference: IWA SWWS2018 15th Conference on Small Water & Wastewater Systems and 7th Conference on Resources Oriented Sanitation At: Haifa, Israel
- 36 Liu X, Fu X, Pu A, Zhang K, Luo H, Anderson BC, Li M, Hunag B, Hu L, Fan L, Chen W, Chen J, Fu S. (Feb 2019) Impact of external carbon source addition on methane emissions from a vertical subsurface-flow constructed wetland. *Greenh gases*, 9(2): 331-348
- 37 Liu L, Hall G, Champagne P. (Aug 2018) Disinfection Processes and Mechanisms in Wastewater Stabilization Ponds: A Review. *Environ Rev*, 26(4):417-429
- 38 Liu X, Zhang K, Fan L, Luo H, Jiang M, Anderson BC, Li M, Hunag B, Yu L, He G, Wang J, Pu A. (Jun 2018). Intermittent micro-aeration control of methane emissions from an integrated vertical-flow constructed wetland during agricultural domestic wastewater treatment. *Environ Sci Pollut R*, 25(24): 24426-24444
- 39 Mahyari F, Rey A, Boegman L, Champagne P, Mulligan R, Hall G, da Silva A, Filion Y (Jul 2018) Three-dimensional simulation of hydrodynamics and water quality in a wastewater stabilization pond. 1st International Water Distribution System Analysis / Computing and Control in the Water Industry Joint Conference, Kingston, Ontario, Canada, July 23-25, 2018
- 40 Marmoush R, Mulligan RP. (Jan 2019) Observations of beach-dune morphological response to storm waves using lidar bathymetric mapping in a wave basin. Conference: 36th Conference on Coastal Engineering At: Baltimore, Maryland, 2018
- 41 McDonald DA. (Dec 2018) Finding common(s) ground in the fight for water remunicipalization. *Community Dev J*, 54(1): 59-79

FACULTY PUBLICATIONS 2018-2019

- 42 McDonald DA. (Nov 2018) Innovation and new public water. *J Econ Policy Reform*, <https://doi.org/10.1080/17487870.2018.1541411>
- 43 McDonald DA. (May 2018). Remunicipalization: The Future of Water Services? *Geoforum*, 91:47-56
- 44 McDonald DA. (2018) "Learning From Corporatization: The Good, the Bad and the Ugly", in Brownlee, J., Hurl, C., and Walby, K. (eds) *Corporatizing Canada, Between the Lines*: Toronto, pp 223-234
- 45 Milley S, Koch I, Fortin P, Archer J, Reynolds D, Weber KP. (Sep 2018). Estimating the Number of Airports Potentially Contaminated with Perfluoroalkyl and Polyfluoroalkyl Substances from Aqueous Film Forming Foam: A Canadian Example. *J Environ Manage*, 222: 122-131
- 46 Mulligan RP, Gomes ER, Miselis JL, McNinch JE. (Apr 2019) Non-hydrostatic numerical modelling of nearshore wave transformation over shore-oblique sandbars. *Estuar Coast Shelf S*, 219: 151-160
- 47 Mulligan RP, Smith PC, Tao J, Hill PS. (May 2019) Wind-wave and Tidally Driven Sediment Resuspension in a Macrotidal Basin. *Estuar Coast*, 42(3): 641-654
- 48 Nakayama K, Sato T, Shimizu K, Boegman L. (Jan 2019) Classification of internal solitary wave breaking over a slope. *Phys Rev Fluids*, 4(1): 014801
- 49 Nakhaei N, Boegman L, Mehdizadeh M, Loewen M. (Apr 2019). Hydrodynamic modeling of Edmonton storm-water ponds. *Environ Fluid Mech*, 19(2): 305-327
- 50 Ouyang X, Chen D, Feng Y, Lei Y. (Jun 2018) Comparison of seasonal surface temperature trend, spatial variability, and elevation dependency from satellite-derived products and numerical simulations over the Tibetan Plateau from 2003 to 2011. *Int J Remote Sens*, 40(5-6): 1844-1857
- 51 Paez D, Suribabu CR, Filion Y (Jul 2018) Performing Extended Period Simulation in EPANET Under Pressure Driven Demands. 1st International Water Distribution System Analysis / Computing and Control in the Water Industry Joint Conference, Kingston, Ontario, Canada, July 23-25, 2018.
- 52 Paez D, Martínez C, Filion Y, Salcedo C, Saldarriaga J (Jul 2018) Improving Convergence Rate of NSGA II with Intermittent Feedback from Energy Based Methods for Design of Water Distribution Systems. 1st International Water Distribution System Analysis / Computing and Control in the Water Industry Joint Conference, Kingston, Ontario, Canada, July 23-25, 2018.
- 53 Paez D, Filion Y, Suribabu CR (Jul 2018) Correlation Analysis of Reliability Surrogate Measures in Real Size Water Distribution Networks. 1st International Water Distribution System Analysis / Computing and Control in the Water Industry Joint Conference, Kingston, Ontario, Canada, July 23-25, 2018.
- 54 Qiu S, Wang L, Champagne P, Cao G, Chen Z, Wang S, Ge S. (Apr 2019) Effects of crystalline nanocellulose on wastewater-cultivated microalgal separation and biomass composition. *Appl Energy*, 239:207-217
- 55 Ramos AC, Regan S, McGinn PJ, Champagne P. (Nov 2018) Feasibility of a Microalgal Waste-water Treatment for the Removal of Nutrients under Non-Sterile Conditions and Carbon Limitation. *Can J Chem Eng*, 97(S1): 1289-1298
- 56 Rey A, Mulligan R, Boegman L, Filion Y, da Silva AM, Champagne P. (Jul 2018) Impact of control structures on Hydraulic retention time in Wastewater Stabilization Ponds Levels. 1st International Water Distribution System Analysis / Computing and Control in the Water Industry Joint Conference, Kingston, Ontario, Canada, July 23-25, 2018.
- 57 Saldarriaga J, Bohórquez J, Celeita D, Vega L, Páez D, Savić D, Dandy G, Filion Y, Grayman W, Kapelan Z. (Apr 2019) Battle of Water Networks District Metering Areas. *J Water Res Pl-ASCE*, 145(4): 04019002
- 58 Sanderson HA, Brown RS, Hania P, McAllister TA, Majury A, Liss SN. (Nov 2018) Antimicrobial Resistant Genes and Organisms as Environmental Contaminants of Emerging Concern: Addressing Global Public Health Risks. In book: *Management of Emerging Public Health Issues and Risks - Multidisciplinary Approaches to the Changing Environment* Edition: 1 Chapter: 7
- 59 Saulnier R, Filion Y (Jul 2018) Examining the Role of Layer Growth Duration on Layer Strength and Turbidity Response in a Full-Scale Laboratory Drinking Water Distribution System at Queen's University. 1st International Water Distribution System Analysis / Computing and Control in the Water Industry Joint Conference, Kingston, Ontario, Canada, July 23-25, 2018.
- 60 Schuh C, Jamieson H, Palmer M, Martin A, Blais J. (Mar 2019) Controls governing the spatial distribution of sediment arsenic concentrations and solid-phase speciation in a lake impacted by legacy mining pollution. *Sci Total Environ*, 654: 563-575

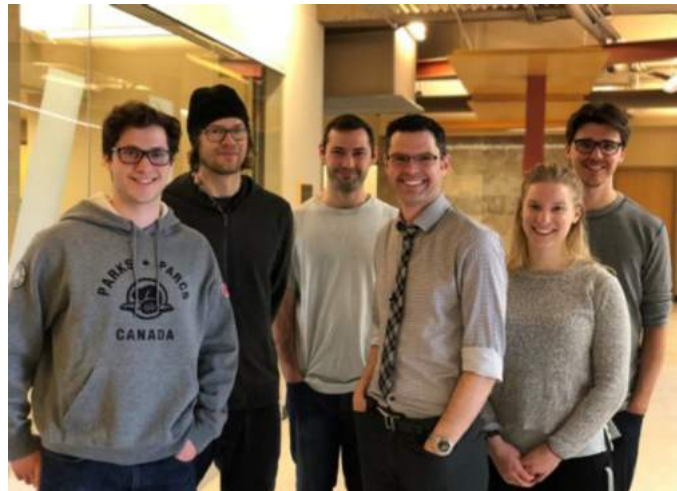
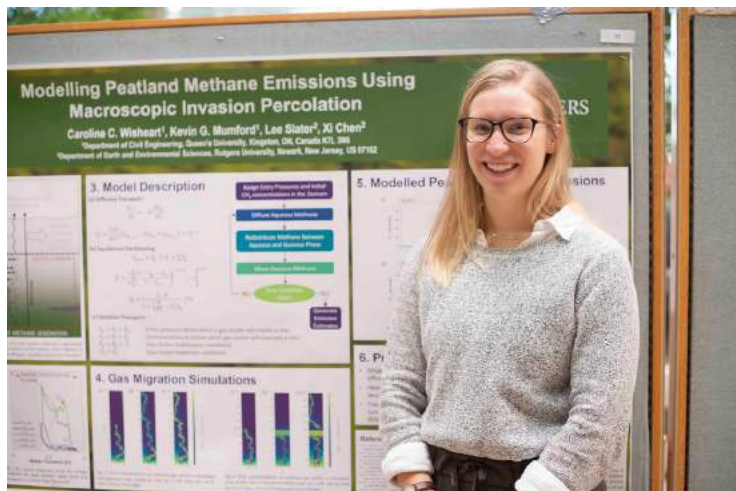
FACULTY PUBLICATIONS 2018-2019

- 61 Simmatis B, Jeziorski A, Zemanek A, Selbie DT, Hyatt KD, Fryer JK, Cumming B, Smol JP. (Sep 2018) Long-term reconstruction of deep-water oxygen conditions in Osoyoos Lake (British Columbia, Canada): implications for Okanagan River sockeye salmon. *Lake Reserv Manage*, 34(4):1-9
- 62 Sinclair JS, Arnott SE. (Jun 2018) Local context and connectivity determine the response of zooplankton communities to salt contamination. *Freshwater Biol*, 63(10): 1273-1286
- 63 Snider B, Filion Y. (Dec 2018) A Streamlined Energy Efficiency Performance Indicator for Water Distribution Systems: A Case Study. *Can J Civil Eng*, 46(1): 61-66
- 64 Song M, Chen D. (Jul 2018) An improved knowledge-informed NSGA-II for multi-objective land allocation (MOLA). *P Soc Photo-Opt Ins*, 21(4): 273-287
- 65 Tenkouano GT, Cumming BF, Jamieson H. (Apr 2019) Geochemical and ecological changes within Moira Lake (Ontario, Canada): A legacy of industrial contamination and remediation. *Environ Pollut*, 247: 980-988
- 66 Tourigny A, Filion Y. (Jan 2018) Sensitivity Analysis of an Agent-Based Model Used to Simulate the Spread of Low-Flow Fixtures for Residential Water Conservation and Evaluate Energy Savings in a Canadian Water Distribution System. *J Water Res Pl-ASCE*, 145(1): 04018086, 1-9.
- 67 Viner K, Champagne P, Jessop P. (Aug 2018) Comparison of Cell Disruption Techniques Prior to Lipid Extraction from *Scenedesmus* sp. Slurries for Biodiesel Production Using Liquid CO₂ *Green Chem*, 20(18): 4330-4338
- 68 Zhang XY, Chuai XW, Liu L, Zhang WT, Lu XH, Zhao LM, Chen DM. (Sep 2018) Decadal Trends in Wet Sulfur Deposition in China Estimated From OMI SO₂ Columns. *J Geophys Res- Atmos*, 123(18), 10,796-10, 811
- 69 Zhang Y, Lyu T, Zhang L, Button M, Arias CA, Weber KP, Shi J, Chen Z, Brix H, Carvalho PN. (Feb 2019) Microbial community metabolic profiles in saturated constructed wetlands treating iohexol and ibuprofen. *Sci Total Environ*, 651(2): 1926-1934

FINANCIAL STATEMENT

May 1, 2018 - April 30, 2019

	Item	Actual
Revenue		
	Carry Forward	0
	Research Projects	\$242,500
	FEAS centre funding	\$40,000
	FEAS Associate Director R&D	\$75,000
	VPR Associate Director R&D	\$60,000
	WatIF Conference Sponsorship	\$5,050
	Total Revenue	\$422,550
Expenses		
	Salaries and Benefits	\$200,994
	Non-salary Expenses (specify)	\$8280.87
	Total Expenses	\$209,275
Surplus (deficit)	This value represents committed funds to support completion of research activities that bridge two separate reporting periods.	\$213,275



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