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Ontario 

**Ontario Geological Survey
Open File Report 6423**

**Ontario Groundwater
Geoscience
2026 Open House**

2026

ONTARIO GEOLOGICAL SURVEY

Open File Report 6423

Ontario Groundwater Geoscience 2026 Open House

Compiled by

A.K. Burt, L.M. Colgrove, D. Ford, S. Holysh, K.J.J. Kalmo, C. Rivard and
S.A. Strynatka

2026

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ONTARIO GROUNDWATER GEOSCIENCE 2026 OPEN HOUSE

Presented by the Ontario Geological Survey,
Geological Survey of Canada, and Conservation Ontario Geoscientists

Ontario Geological Survey Open File Report 6423

Compiled by

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Ressources naturelles
Canada

Natural Resources
Canada



February 10, 2026

Waterloo, Ontario

February 12, 2026

Virtual Meeting

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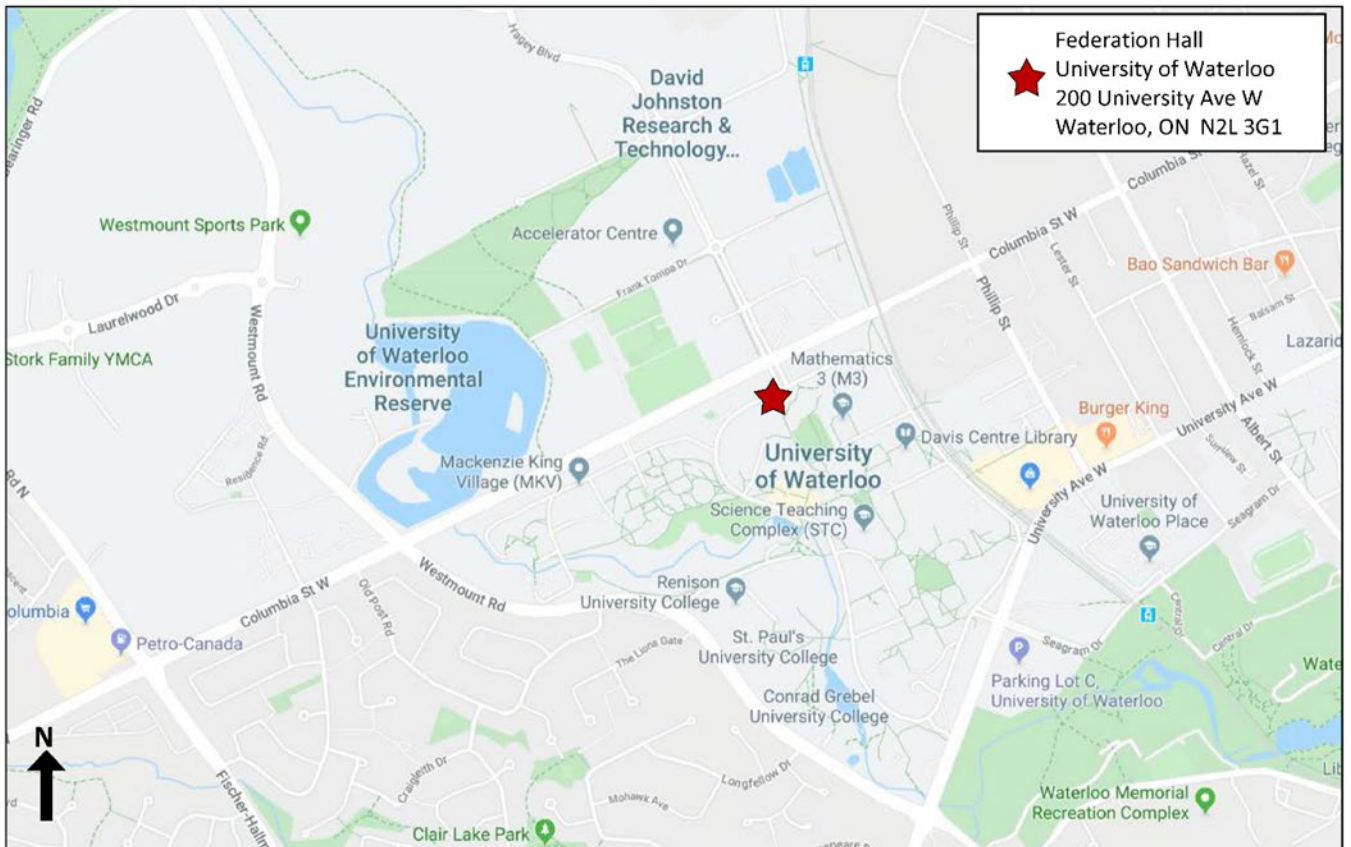
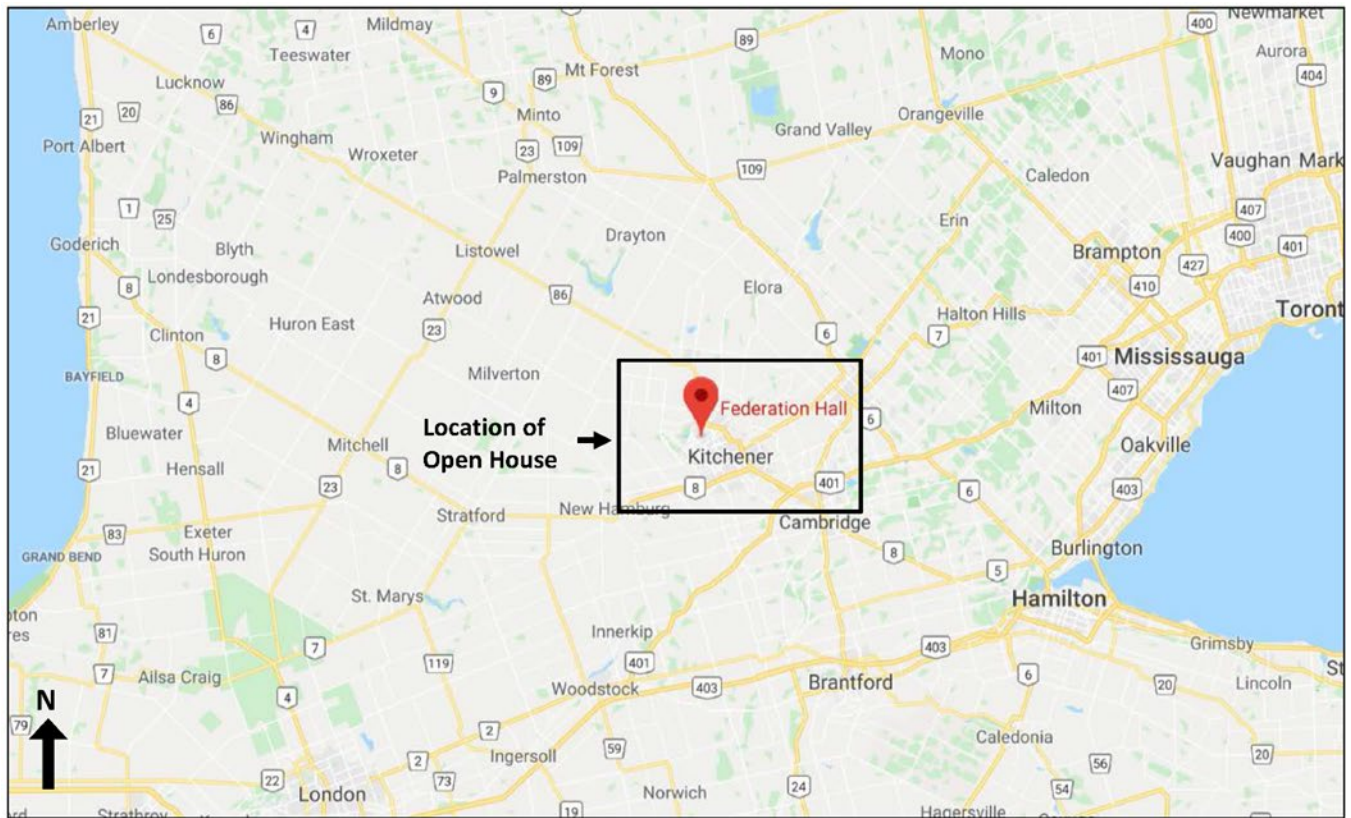
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Location Map



Program

February 10 In-Person Oral Presentations

START	END	TITLE	PRESENTER	AFFILIATION	THEME	
8:00	9:00	Coffee and Networking				
9:00	9:10	Opening Remarks	Hosts	OGS, GSC		
9:10	9:25	So Much More Than Just Gravel	Burt	OGS	Aquifer Geology	
9:25	9:40	Diving Down Through the Dirt: Unique Aspects of the Sediment–Bedrock Interface	Mulligan	OGS		
9:40	9:55	Paleozoic Mapping Activities in Eastern and South-Central Ontario	Hahn	OGS		
9:55	10:10	Preliminary Evaluation of a Borehole Nuclear Magnetic Resonance (NMR) Logging Tool in Precambrian Basement Rock	Crow	GSC		
10:10	10:55	Networking and Poster Break				
10:55	11:10	Mapping Canada’s Groundwater Governance Innovations and Gaps: A Landscape Perspective	Garrick	University of Waterloo	Management and Groundwater Data Dissemination	
11:10	11:25	Groundwater Management in Ontario: A Look Back – A Look Ahead	Holysh	ORMGP		
11:25	11:40	The Guelph Groundwater Model: Innovation and Collaboration for Effective Water Management	Munn	City of Guelph		
11:40	11:55	A Quarter Century of Groundwater Recharge at Milton Quarry	Murphy	GHD Limited		
11:55	12:10	The Renewal of the Groundwater Information Network (GIN)	Létourneau	GSC		
12:10	13:15	Lunch				
13:15	13:30	Development of an Aquifer Capability Screening Tool for the City of Ottawa	Di Iorio, West	City of Ottawa, Stantec Consulting Ltd.	Groundwater Flow, Quality and Contaminants	
13:30	13:45	Groundwater Project in the Lower Grand River Watershed: 2025 Status of Research	Rivard	GSC		
13:45	14:00	Potential Fault Control on Fluid Migration in the Shallow Groundwater of the Western Part of the Niagara Peninsula	Lavoie	GSC		
14:00	14:15	Characterizing Nutrient Loading Risk to Surface Water and Groundwater with a Fully Integrated Surface Water–Groundwater Model	Frey	Aquanty Inc.		
14:15	15:00	Networking and Poster Break				
15:00	16:30	Nutrients: Friend or Foe?	Ford, Robinson, Levison, Ivey, Basu	TRCA, University of Western Ontario, University of Guelph, GRCA, University of Waterloo	Panel Discussion	
16:30	16:35	Wrap-up				

Program (*continued*)

February 10 In-Person Poster Presentations

	TITLE	PRESENTER	AFFILIATION
1	Water Resource Data Availability for Isolated First Nations Communities and Watersheds in Treaty 9	Dixon-Bolen	University of Waterloo
2	Identifying Groundwater Contributions to Streamflow During Winter Within Alder Creek Watershed	Forte	University of Waterloo
3	Assessment of Direct Groundwater Discharge to Nearshore Waters Along the Northwestern Shoreline of Lake Ontario	Kings	University of Western Ontario
4	Hidden Connections: How Groundwater–Surface Water Interactions Shape Chloride Dynamics in an Urban Stream	Mackie	University of Guelph
5	Investigating Groundwater Flow and Groundwater–Surface Water Interactions Under Climate Change in the Lower Grand River Watershed	Momin	University of Guelph
6	Modelling the Influences of Tile Drain Design on Water Balance and Nutrient Transport in Midwestern Ontario	Mulkerns	University of Guelph
7	Role of Subsurface Drainage Infrastructure as a Pathway for Wastewater Contaminants to Reach Streams from On-Site Wastewater Treatment Systems	Santos	University of Western Ontario
8	A Coupled Hydro-Economic Modelling Framework for Sustainable Groundwater Irrigation: Insights and Applications Relevant to Ontario Agriculture	Tian	University of Waterloo
9	Identification of Groundwater Salt Plumes Along the Highly Urbanized Lake Ontario Shoreline Using Geophysical Techniques	Zhu	University of Western Ontario

February 10 In-Person Booths

	TITLE	PRESENTER	AFFILIATION
1	Well-Known Aquifers: A 3-D View of the Oak Ridges Moraine	Clark	OGSRL
2	Enabling Future-Ready Geoscientists and Geological Engineers	Johnston	University of Waterloo
3	University of Waterloo Earth Sciences Museum	McDonald	University of Waterloo
4	The Role of Professional Geoscientists Ontario (PGO): Regulating the Practice of Geoscience in Ontario	Atmore	PGO
5	Ontario Geological Survey	Yeung	OGS
6	IAH Canada – Your National Organization	Ford, McClain	TRCA, University of Calgary

Program (*continued*)

February 12 Virtual Oral Presentations

START	END	TITLE	PRESENTER	AFFILIATION
13:00	13:10	Housekeeping and Opening Remarks	Hosts	OGS, CO
13:10	13:25	Canada and Groundwater Level Monitoring Networks: Taking Stock from an International and Provincial Context	Russell	GSC
13:25	13:40	Ontario's Groundwater Programs: Updates, Priorities, and 25 Years of PGMN	Brodie-Brown	MECP
13:40	13:55	Legacy Log Lithology Linked to Layers: Gathering the Goods for Geoscience and Groundwater Guidance	Mulligan	OGS
13:55	14:00	Discovering 135 Years of Geoscience Data in Ontario	Yeung	OGS
14:00	14:10	Break		
14:10	14:25	Ambient Groundwater Geochemistry Project: Mapping North-Central Ontario	Colgrove	OGS
14:25	14:30	Beneath the Boreal: Update on the Ambient Groundwater Geochemistry Project of the Thunder Bay Area	Handley	OGS
14:30	14:35	Student Spotlight: Modelling the Influences of Tile Drain Design on Water Balance and Nutrient Transport in Midwestern Ontario	Mulkerns	University of Guelph
14:35	14:50	Student Spotlight: Methods for Sampling Nitrate During a Storm Event – Successes and Limitations	Zeuner	University of Guelph
14:50	15:05	The Occurrence and Migration of Per- and Polyfluoroalkyl Substances (PFAS) in Landfill Leachate, Groundwater and Drinking Water Wells in Ontario, Canada	Rodrigues	MECP
15:05	15:15	Break		
15:15	15:20	Student Spotlight: Investigating Groundwater Flow and Groundwater–Surface Water Interactions Under Climate Change in the Lower Grand River Watershed	Momin	University of Guelph
15:20	15:35	The Gang's All Here – A Collaborative Approach to Geological Investigations	Burt	OGS
15:35	15:40	An "Aggregate" Approach to Groundwater Resource Management	Handley	OGS
15:40	15:45	Results from the Recent Ground Gravity Survey in the Guelph Area	Biswas	OGS
15:45	16:00	The Role of Professional Geoscientists Ontario (PGO): Regulating the Practice of Geoscience in Ontario	Miguel	PGO
16:00	16:10	Discussion and Wrap-up		

Context

The 2026 Ontario Groundwater Geoscience Open House (“Open House”) is co-hosted by the Ontario Geological Survey (OGS), Geological Survey of Canada (GSC) and Conservation Ontario (CO). The purpose is to provide an avenue to communicate updates and results from publicly funded groundwater projects, discuss new advances in groundwater science with stakeholders and the public, and provide a space to spark collaboration within the groundwater science community. The Open House is attended by government (federal, provincial, municipal), consulting companies, academic institutions, conservation authorities, not-for-profit organizations, Indigenous communities and others.

The 2026 event is the 11th year of the Open House, which began in 2016 as a response to a gap analysis identifying the need for improved communication among groups of groundwater practitioners, mappers and researchers, to maximize opportunities for collaboration and minimize duplication of efforts. Early years focussed on sharing results of collaborative groundwater mapping projects between the OGS and GSC. The Open House has evolved since its inception: growing from 1 day to 2 days, partnering with Conservation Ontario, developing an annual panel discussion, showcasing student work through posters and lightning talks, and adding virtual talks and live streaming for those who cannot attend in person. The event started with 96 participants in 2016 and grew to 791 total registrants (in-person and virtual) in 2025, with people tuning in from across Canada and 15 other countries. The first 10 years of the event saw

- over 3750 registered participants
- a 95% average overall satisfaction from polled participants
- 238 talks
- 20 lightning talks
- 6 panel discussions
- 107 posters

The 2026 program involves an in-person event on February 10 with a virtual live-stream and a virtual-only half-day on February 12. The in-person event, at the University of Waterloo’s Federation Hall, will include full length talks, the annual panel discussion, a student poster session, 5 demonstration booths and networking breaks. As in previous years, we trust that the 2026 open house will remain a valuable forum for sharing groundwater information and networking with peers. Join us to engage with groundwater geoscience experts, meet with old and new colleagues, and learn about studies shaping the future of Ontario’s water.

Acknowledgments

Day 1 has been sponsored by a contribution to the Conservation Ontario Geoscientists Group by the International Association of Hydrogeologists Canadian National Chapter (IAH–CNC). The time and effort of the workshop presenters and their respective agencies is much appreciated. An internal review at the OGS by R.M. Easton is much appreciated.

Context (*continued*)

Associated Publications

Associated publications of previous gap analysis, workshop(s) and open houses between 2015 and 2025 are available.

2015

Russell, H.A.J., Priebe, E.H. and Parker, J.R. 2015. Workshop summary and gap analysis report: Unifying groundwater science in southern Ontario; Ontario Geological Survey, Open File Report 6310, 64p.
www.geologyontario.mines.gov.on.ca/persistent-linking?publication=OFR6310

Russell, H.A.J. compiler. 2015. Workshop on Groundwater Data Framework and Hydrogeology Model, Southern Ontario; Geological Survey of Canada. (no formal publication, see **Groundwater Information Network** at the end of this section)

2016

Russell, H.A.J. and Priebe, E.H. compilers. 2016. Regional-scale groundwater geoscience in southern Ontario: An Ontario Geological Survey and Geological Survey of Canada Groundwater Geoscience Open House; Geological Survey of Canada, Open File 8022, 34p. doi.org/10.4095/297722

2017

Russell, H.A.J., Ford, D. and Priebe, E.H. compilers. 2017. Regional-scale groundwater geoscience in southern Ontario: An Ontario Geological Survey, Geological Survey of Canada, and Conservation Ontario Geoscientists Open House; Geological Survey of Canada, Open File 8212, 56p. doi.org/10.4095/299750

2018

Russell, H.A.J., Ford, D., Priebe, E.H. and Holysh, S. compilers. 2018. Regional-scale groundwater geoscience in southern Ontario: An Ontario Geological Survey, Geological Survey of Canada, and Conservation Ontario Geoscientists Open House; Geological Survey of Canada, Open File 8363, 62p. doi.org/10.4095/306472

2019

Russell, H.A.J., Ford, D., Holysh, S. and Priebe, E.H. compilers. 2019. Regional-scale groundwater geoscience in southern Ontario: An Ontario Geological Survey, Geological Survey of Canada, and Conservation Ontario Geoscientists Open House; Ontario Geological Survey, Open File Report 6349 / Geological Survey of Canada, Open File 8528 (doi.org/10.4095/313529), 32p. www.geologyontario.mines.gov.on.ca/persistent-linking?publication=OFR6349

2020

Priebe, E.H., Ford, D., Holysh, S., Russell, H.A.J. and Nadeau, J.E. compilers. 2020. Regional-scale groundwater geoscience in southern Ontario: An Ontario Geological Survey, Geological Survey of Canada, and Conservation Ontario Geoscientists Open House; Ontario Geological Survey, Open File Report 6361, 46p.
www.geologyontario.mines.gov.on.ca/persistent-linking?publication=OFR6361

2021

Priebe, E.H., Ford, D., Holysh, S., Nadeau, J.E. and Russell, H.A.J. compilers. 2022. Regional-scale groundwater geoscience in southern Ontario: The 2021 Ontario Geological Survey, Geological Survey of Canada, and Conservation Ontario Geoscientists Open House; Ontario Geological Survey, Open File Report 6378, 24p.
www.geologyontario.mines.gov.on.ca/persistent-linking?publication=OFR6378

Context (*continued*)

2022

Burt, A.K., Ford, D., Holysh, S., Karmo, K.J.J. and Russell, H.A.J. compilers. 2022. Regional-scale groundwater geoscience in southern Ontario: The 2022 Ontario Geological Survey, Geological Survey of Canada, and Conservation Ontario Geoscientists Open House; Ontario Geological Survey, Open File Report 6379, 38p.
www.geologyontario.mines.gov.on.ca/persistent-linking?publication=OFR6379

2023

Burt, A.K., Ford, D., Holysh, S., Karmo, K.J.J. and Russell, H.A.J. compilers. 2023. Regional-scale groundwater geoscience in southern Ontario: The 2023 Ontario Geological Survey, Geological Survey of Canada, and Conservation Ontario Geoscientists Open House; Ontario Geological Survey, Open File Report 6387, 61p.
www.geologyontario.mines.gov.on.ca/persistent-linking?publication=OFR6387

2024

Burt, A.K., Colgrove, L.M., Karmo, K.J.J., Ford, D., Holysh, S. and Russell, H.A.J. compilers. 2024. Ontario Groundwater Geoscience 2024 Open House; Ontario Geological Survey, Open File Report 6406, 47p.
www.geologyontario.mines.gov.on.ca/persistent-linking?publication=OFR6406

2025

Burt, A.K., Colgrove, L.M., Karmo, K.J.J., Ford, D., Holysh, S. and Rivard, C. compilers. 2025. Ontario Groundwater Geoscience 2025 Open House; Ontario Geological Survey, Open File Report 6414, 48p.
www.geologyontario.mines.gov.on.ca/persistent-linking?publication=OFR6414

Note: This publication includes abstracts by staff of the Ministry of Energy and Mines (Ontario Geological Survey) and the Ministry of Environment, Conservation and Parks. Because an Election Writ was in place at the time of the Open House, the presentations associated with these abstracts were withdrawn.

2026

Burt, A.K., Colgrove, L.M., Ford, D., Holysh, S., Karmo, K.J.J., Rivard, C. and Strynatka, S.A. compilers. 2026. Ontario Groundwater Geoscience 2026 Open House; Ontario Geological Survey, Open File Report 6423, 56p.
www.geologyontario.mines.gov.on.ca/persistent-linking?publication=OFR6423

Presentations from 2021, 2022, 2023, 2024 and 2025 are available on the GSC Groundwater Geoscience Program YouTube channel under Playlists (www.youtube.com/channel/UChIc7ff3vEdII708VhgsLsg/playlists). Some presentations may be missing and, in those cases, permission was not granted by the respective organization of the author(s).

Contents

► Location Map.....	v
► Program.....	vi
February 10 In-Person Oral Presentations	vi
February 10 In-Person Poster Presentations	vii
February 10 In-Person Booths	vii
February 12 Virtual Oral Presentations.....	viii
► Context	ix
Acknowledgments.....	ix
Associated Publications.....	x
► Oral Presentations	1
► Results from the Recent Ground Gravity Survey in the Guelph Area.....	2
Biswas, Saurav; and John Evangelatos	
► Ontario’s Groundwater Programs: Updates, Priorities, and 25 Years of Ontario’s Provincial Groundwater Monitoring Network	3
Brodie-Brown, Heather; and Helen Zhang	
► The Gang’s All Here – A Collaborative Approach to Geological Investigations.....	4
Burt, Abigail K.	
► So Much More Than Just Gravel	5
Burt, Abigail K.; Leslea McKie and Lesley Veale	
► Ambient Groundwater Geochemistry Project: Mapping North-Central Ontario	6
Colgrove, Laura M.	
► Preliminary Evaluation of a Borehole Nuclear Magnetic Resonance (NMR) Logging Tool in Precambrian Basement Rock	7
Crow, Heather L.; Peeter Pehme, Stephanie Wright, Kent Novakowski and Hazen A.J. Russell	
► Development of an Aquifer Capability Screening Tool for the City of Ottawa	8
Di Iorio, Tessa; and Ant West	
► Nutrients: Friend or Foe?.....	10
Ford, Donald C.; Clare E. Robinson, Jana Levison, Janet Ivey and Nandita Basu	
► Characterizing Nutrient Loading Risk to Surface Water and Groundwater with a Fully Integrated Surface Water–Groundwater Model.....	11
Frey, Steven K.; Jeff Melchin, Bruce Xu, Eric Kessel, Helen Zhang, Omar Khader and Keshav Mahadevan	
► Mapping Canada’s Groundwater Governance Innovations and Gaps: A Landscape Perspective.....	12
Garrick, Dustin; Mike Wei, Diana Paredes, Sophie Bhalla, Sessinou Houedanou, Isabel Jorgensen, Hillary Sutton, Jonathon Keizer, Aislin Livingstone and Alan Shapiro	
► Paleozoic Mapping Activities in Eastern and South-Central Ontario.....	14
Hahn, Katie E.; Catherine Béland Otis and Frank R. Brunton	
► An “Aggregate” Approach to Groundwater Resource Management.....	15
Handley, Laura A.	

Contents (continued)

► Beneath the Boreal: Update on the Ambient Groundwater Geochemistry Project of the Thunder Bay Area	16
Handley, Laura A.; and Kayla M. Dell	
► Groundwater Management in Ontario: A Look Back – A Look Ahead	17
Holysh, Steve; Rick Gerber, Mason Marchildon, Mike Doughty, Steve Shikaze and Britt Smith	
► Potential Fault Control on Fluid Migration in the Shallow Groundwater of the Western Part of the Niagara Peninsula	18
Lavoie, Denis; Omid Haeir Ardakani, Stewart M. Hamilton and Christine Rivard	
► The Renewal of the Groundwater Information Network (GIN)	20
Létourneau, François; Simon Gagnon, Éric Boisvert and Boyan Brodaric	
► The Role of Professional Geoscientists Ontario (PGO): Regulating the Practice of Geoscience in Ontario	21
Miguel, Marilen; Eilidh Lewis and Gabrielle Hosein	
► Investigating Groundwater Flow and Groundwater–Surface Water Interactions Under Climate Change in the Lower Grand River Watershed	22
Momin, Hafsa; Jana Levison, Christine Rivard and Steven K. Frey	
► Modelling the Influences of Tile Drain Design on Water Balance and Nutrient Transport in Midwestern Ontario	24
Mulkerns, Lauren; Jana Levison, Colby Steelman and Emmanuelle Arnaud	
► Diving Down Through the Dirt: Unique Aspects of the Sediment–Bedrock Interface	25
Mulligan, Riley P.M.; Abigail K. Burt, Ashok Shaw, Emmanuelle Arnaud and Roger C. Paulen	
► Legacy Log Lithology Linked to Layers: Gathering the Goods for Geoscience and Groundwater Guidance ...	26
Mulligan, Riley P.M.; Abigail K. Burt, Kei H. Yeung and Frank R. Brunton	
► The Guelph Groundwater Model: Innovation and Collaboration for Effective Water Management	27
Munn, Jonathan; Emily Stahl, Ashok Shaw, Emmanuelle Arnaud and Albanie Douglas	
► A Quarter Century of Groundwater Recharge at Milton Quarry	29
Murphy, J. Richard; Kyle Fritz, William Armes and Thomas Guoth	
► Groundwater Project in the Lower Grand River Watershed: 2025 Status of Research	30
Rivard, Christine; Geneviève Bordeleau, Denis Lavoie, Abigail K. Burt, Heather L. Crow, Paige Murray, Hafsa Momin, Julie Pera Muraski, Jana Levison, Steven K. Frey, Rohini Patel and Dawn Martin-Hill	
► The Occurrence and Migration of Per- and Polyfluoroalkyl Substances (PFAS) in Landfill Leachate, Groundwater and Drinking Water Wells in Ontario, Canada	31
Rodrigues, Luciana	
► Canada and Groundwater Level Monitoring Networks: Taking Stock from an International and Provincial Context	32
Russell, Hazen A.J.; Steven K. Frey, Shusen Wang, John Crowley, Melissa Bunn and Éric Boisvert	
► Discovering 135 Years of Geoscience Data in Ontario	33
Yeung, Kei H.; and John E.P. Dodge	
► Methods for Sampling Nitrate During a Storm Event – Successes and Limitations	34
Zeuner, Christina; Jana Levison and Marie Larocque	

Contents (continued)

■ Poster Presentations	35
Student Spotlights	
■ Investigating Groundwater Flow and Groundwater–Surface Water Interactions Under Climate Change in the Lower Grand River Watershed	22
see Momin, Hafsa; Jana Levison, Christine Rivard and Steven K. Frey	
■ Modelling the Influences of Tile Drain Design on Water Balance and Nutrient Transport in Midwestern Ontario.....	24
see Mulkerns, Lauren; Jana Levison, Colby Steelman and Emmanuelle Arnaud	
■ Water Resource Data Availability for Isolated First Nation Communities and Watersheds in Treaty 9	36
Dixon-Bolen, Braeden; and Randy L. Stotler	
■ Identifying Groundwater Contributions to Streamflow During Winter Within the Alder Creek Watershed ...	37
Forte, Michael J.; and Randy L. Stotler	
■ Assessment of Direct Groundwater Discharge to Nearshore Waters Along the Northwestern Shoreline of Lake Ontario.....	38
Kings, Meghan A.; James W. Roy, Christopher Power, Kayla Bruce and Clare E. Robinson	
■ Hidden Connections: How Groundwater–Surface Water Interactions Shape Chloride Dynamics in an Urban Stream	39
Mackie, Ceilidh; Jana Levison, Valerie Risch and James W. Roy	
■ Role of Subsurface Drainage Infrastructure as a Pathway for Wastewater Contaminants to Reach Streams from On-Site Wastewater Treatment Systems	40
Santos, Arielle J.; James W. Roy, Christopher Jobity, Thomas E. Edge and Clare E. Robinson	
■ A Coupled Hydro-Economic Modelling Framework for Sustainable Groundwater Irrigation: Insights and Applications Relevant to Ontario Agriculture	41
Tian, Boyao; Andrea Brookfield, Margaret Insley and David Rudolph	
■ Identification of Groundwater Salt Plumes Along the Highly Urbanized Lake Ontario Shoreline Using Geophysical Techniques.....	42
Zhu, Junwei; Christopher Power, James W. Roy and Clare E. Robinson	
■ Booth Descriptions.....	43
■ The Role of Professional Geoscientists Ontario (PGO): Regulating the Practice of Geoscience in Ontario	44
Atmore, Lauren; Melanie Siewert, Gabrielle Hosein and Marilen Miguel	
■ Well-Known Aquifers: A 3-D View of the Oak Ridges Moraine	45
Clark, Jordan K.; Connor MacLeod and Matthew Dupont	
■ IAH Canada – Your National Organization	46
Ford, Donald C.; and Cynthia N. McClain	
■ Enabling Future-Ready Geoscientists and Geological Engineers.....	47
Johnston, John W.; Heidi Daxberger and Erica Refling	
■ University of Waterloo Earth Sciences Museum	48
McDonald, Corina	
■ Ontario Geological Survey	49
Yeung, Kei H.; and John E.P. Dodge	
■ Presenters, Authors and Key Participants	50
■ Metric Conversion Table	56

Oral Presentations

Results from the Recent Ground Gravity Survey in the Guelph Area

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The Ontario Geological Survey (OGS) commissioned a ground gravity survey in the Guelph area to support the Guelph three-dimensional (3-D) sediment mapping project. As a result, 3394 gravity measurements along 17 survey lines were collected in the fall of 2023 and published in 2025 (Ontario Geological Survey 2025). Rigorous quality assurance and quality control (QA/QC) have been conducted on the data to ensure that OGS specifications are met (absolute repeat difference <0.01 mGal). The Bouguer gravity anomalies and terrain corrections were calculated for a slab density of 2.10 g/cm³, which is the same as that of the adjoining 2013 gravity survey to the north in the Orangeville area. The Bouguer gravity anomalies are plotted along the 17 profiles for further investigation. Results from 2 approaches in calculating the gravity residuals are presented in this study. In the first approach, the gravity readings from the Guelph survey are merged with pre-existing publicly available ground gravity data in the region. The combined gravity data are extended upward to 2 km to calculate the regional gravity in the study area. The regional gravity is then subtracted from the Bouguer gravity anomalies to calculate the residual. The low gravity residuals from this first approach correlated well with prominent valley (topographic lows) in bedrock elevation. To find more subtle valley features in the bedrock elevation, a polynomial regression technique was undertaken. For this second approach, the third- and fifth-order polynomial curves fitting the Bouguer gravity anomalies are calculated and then subtracted from the Bouguer gravity anomalies to produce the residual gravity. These residuals highlight subtler low features in some cases. The low features in the residual Bouguer gravity anomalies indicate lower density subsurface materials. Hence, these low features can be used to interpret thalwegs in buried-bedrock valleys. This study highlights 2 such features as examples: L8 (at 1 km distance from northwest end of the profile) in the northern and L3 (at 2.8 km distance from northwest end of the profile) in the southern parts of the study area. These features can be investigated further by drilling cored boreholes for possible buried-bedrock valleys and to characterize the subsurface within the Guelph area.

Reference

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Ontario's Groundwater Programs: Updates, Priorities, and 25 Years of Ontario's Provincial Groundwater Monitoring Network

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The Ontario government is committed to protecting our lakes, waterways and groundwater supply—now and for future generations—while supporting economic growth and timely approvals for projects that drive prosperity. Groundwater is a vital resource, underpinning Ontario's communities, Indigenous traditional activities, and healthy ecosystems, while sustaining agriculture, industry and recreation.

The Ministry of the Environment, Conservation and Parks (MECP) delivers a range of groundwater programs that enable and provide sustainable water management and informed decision-making. Drinking Water and Environmental Compliance Divisions Technical Support, the ministry's regional frontline, support approvals, compliance, complaints, mitigation and abatement, and guidance development for all types of sites and issues. Environmental Permissions Division and Environmental Sciences and Standards Division (ESSD) have hydrogeologists who support Brownfields, contaminated sites and Permit to Take Water programs. Land and Water Division deals with all manner of policy and program development issues. Land and Water Division is supported by in-house groundwater expertise for Source Protection and ESSD hydrogeologists for Great Lakes.

A cornerstone of these efforts is Ontario's Provincial Groundwater Monitoring Network (PGMN), a partnership between MECP, Ontario's Conservation Authorities, and the Severn Sound Environmental Association. Established in response to the 1999 drought and the Walkerton tragedy, PGMN has provided long-term groundwater level and chemistry data from up to 500 wells across the province since 2000. Over 25 years, the program has evolved to support climate resilience, integrated groundwater-surface water monitoring, and near real-time data sharing to inform planning and approvals.

This presentation will highlight

- PGMN at 25 years
- Recent and upcoming enhancements to PGMN
- Ministry-wide groundwater initiatives
- Great Lakes collaborative groundwater studies

The Gang's All Here – A Collaborative Approach to Geological Investigations

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Provincial and federal government, municipalities, conservation authorities, industry and academia have different, yet complimentary, roles in quantifying and protecting our most precious resource—water. The Ontario Geological Survey (OGS) is currently collaborating on 5 projects in southwestern Ontario extending from Mount Forest in the north to Lake Erie in the south. Straddling a regional-scale interlobate zone that developed after the last glacial maximum (LGM), the projects present a unique opportunity to examine high-quality cored sediments from the LGM “regional” till, as well as Lake Huron–Georgian Bay and Erie–Ontario tills, and glaciofluvial and glaciolacustrine deposits that comprise large, stratified moraine systems providing geologic context for evaluating the groundwater flowing through these units.

Mount Forest–Elmira three-dimensional (3-D) sediment mapping project is supporting updates to community wellhead protection zones in Wellington County and improving the Grand River Conservation Authority monitoring well network in the northern part of the watershed (Burt, Strynatka and Baxter 2025). This is the first OGS drilling campaign focused north of the interlobate zone and is providing early insight into the subsurface stratigraphy.

The Guelph area 3-D sediment mapping project is supporting updates to the City of Guelph numerical groundwater flow model and search for water to supply a growing population within the City of Guelph and Region of Waterloo (Burt 2025a). The University of Guelph advised on borehole and monitoring locations and the Region of Waterloo converted a borehole into a deep monitoring well.

A recent drilling and monitoring well installation program by the Region of Waterloo provided an opportunity for the OGS to obtain high-quality core that can provide contextual information for ongoing 3-D mapping projects and augment existing publicly available data sets (Burt and McKie 2025). Similarly, a Ministry of Natural Resources driven project in Norfolk County investigating artesian flow of methane and sulphur-rich groundwater, is setting the stage for future 3-D modelling efforts (Burt 2025b).

The Lower Grand River Watershed project is a Geological Survey of Canada-led multi-agency collaboration exploring the sources and impacts of natural and anthropogenic contamination (Rivard et al., this volume). Ongoing sediment and bedrock coring is supplementing previous OGS work on the Niagara Peninsula and will provide the data required to complete a 3-D model in that area.

This talk will briefly introduce the projects and demonstrate the value of a collaborative approach to geological investigations and paves the way for future science-based decision making on land-use planning and resource management.

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- Burt, A.K., Strynatka, S.A. and Baxter, J. 2025. Drilling down in Mount Forest–Elmira; *in* Summary of Field Work and Other Activities, 2025, Ontario Geological Survey, Open File Report 6421, p.19-1 to 19-7.

So Much More Than Just Gravel

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Ontario Geological Survey three-dimensional (3-D) sediment mapping projects are aimed at better understanding the architecture and internal properties of the Quaternary sediment sequence for land-use planning, groundwater and other resource management applications. Lidar-derived elevation models reveal landform evidence of late- and post-glacial events and simple ground-truthing confirms and/or constrains predicted sediment characteristics, such as texture and permeability. Interpreting and understanding older (buried) events and sediments, however, becomes progressively more challenging with depth. High-quality, continuously cored boreholes, ideally supplemented by downhole geophysical logs, are the foundational dataset for interpreting lower quality boreholes and water well records.

Recent drilling and monitoring well installation programs by the Ontario Geological Survey (Burt 2025) and Regional Municipality of Waterloo (Burt and McKie 2025) have provided both valuable data and the impetus to explore some of the most prolific and important water-bearing sediments—buried gravel and cobbles—more closely. Gravel can be deposited in many glacial and non-glacial settings, from deep beneath the ice to ice margins and beyond to outwash plains, rivers and beaches. The thickness, lateral continuity, associated stratigraphic units and internal characteristics of each depositional setting will impact the flow of water through the subsurface. Careful evaluation of gravel-rich packages within a broader geological context will increase predictive power resulting in more plausible 3-D sediment and numerical groundwater flow models. Although coring is expensive, the benefits can—and should—be considered a necessary component of risk management.

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Ambient Groundwater Geochemistry Project: Mapping North-Central Ontario

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The Ambient Groundwater Geochemistry Project (AGGP) aims to map the chemistry of groundwater at the regional scale in order to establish a baseline, study geological controls on groundwater chemistry and better understand aquifer flow and conditions. With completed mapping of southern Ontario (MRD283—Rev2: Hamilton 2021) and northeastern Ontario (MRD401: Dell and Hamilton 2024), efforts have turned toward the more-than-100 km wide gap between the 2 areas. Groundwater sampling started in the Ottawa Valley in 2024 (Colgrove 2024) and continued in 2025 (Colgrove 2025) in the Bancroft–North Frontenac areas to work toward infilling the gap. A total of 243 samples have been collected to date, although full compilation and quality-control analysis are currently ongoing. The data set will include nearly 100 analytes, including chemical, bacteriological, isotopic and radiological parameters. Program details and early observations of the data will be shared.

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Preliminary Evaluation of a Borehole Nuclear Magnetic Resonance (NMR) Logging Tool in Precambrian Basement Rock

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The estimation of *in situ* hydraulic parameters in aquifer systems is an essential part of investigating groundwater flow and contaminant transport. The Geological Survey of Canada (GSC) and the Morwick G360 Groundwater Research Institute have been collaborating on an evaluation of slim-hole geophysical nuclear magnetic resonance (NMR) logging tools in southern Ontario boreholes (Pehme et al. 2022; Crow et al. 2022). These instruments were originally developed to estimate water content continuously along a borehole wall (porosity and pore size distribution) in sedimentary rock and unconsolidated sediments using strong magnetic fields. Little research has been published on the application of NMR in igneous or metamorphic rock, and our effort has not yet been able to address NMR responses in Precambrian basement rock intersected at the Ottawa test site due to influence from elevated magnetic mineral content. Collaborations with Queen's University in July 2025 at their extensively studied borehole research station in basement rock near Tamworth, Ontario, found magnetic conditions to be favourable for NMR logging. Data were collected in one 46 m-borehole intersecting fractured gneissic (felsic) bedrock. An extensive suite of borehole geophysical, hydrogeological and core data (fracture frequency, mineralogy, lab porosity) were available to support the NMR interpretation. The NMR logs were collected in both stepped and continuous modes to examine the influence of collection parameters and data stacking in a very low matrix porosity setting (0.2–0.6% from 4 core samples). Preliminary results indicate that 1) the matrix porosity is difficult to quantify due to low bound water content (very low signal-to-noise), 2) fracture porosity on the order of 1% appears to emerge as a separate and identifiable signature, a value which exceeds *in situ* estimates of fracture porosity based on transmissivity values obtained from packer testing, and 3) NMR response at these low water contents is very sensitive to small variations in magnetic susceptibility. Overlays of fracture frequency and the NMR "mobile water" fraction show common trends, suggesting that NMR, when viewed alongside other geophysical logs, could be used in low magnetic susceptibility crystalline rock settings to interpret water-bearing features to support subsequent hydrogeological testing, but this will require more research. Work continues to refine and adapt the NMR data processing in crystalline rock based on comparison to other data sets.

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Development of an Aquifer Capability Screening Tool for the City of Ottawa

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The City of Ottawa, in partnership with the Ontario Geological Survey (OGS), has undertaken a multi-year groundwater sampling and mapping program to support development planning in rural areas reliant on private wells. The objective of this initiative was to develop an Aquifer Capability Screening Tool (ACST)—an easy-to-use geographic information system (GIS) resource designed to help planners and agencies evaluate the potential for sustainable groundwater supply on a property prior to undertaking on-site investigations.

A comprehensive well sampling program took place in 2017, 2019 and 2022 at a combined 799 private wells across the rural east, west and south regions of Ottawa, respectively (Figure 1). Site selection and sampling procedures generally followed the Ontario Ambient Groundwater Geochemistry Program (AGGP) (Hamilton, Brauneder and Mellor 2007). A uniform spatial distribution of samples was achieved by collecting 1 bedrock groundwater sample from each 2 km² sampling grid cell and 1 shallow overburden groundwater sample from every other cell. Residents opted into the sampling program following public advertisement campaigns, and well owner interviews were completed during site visits along with well measurements, groundwater field analyses and sampling. Groundwater samples were analyzed for a broad suite of chemical, bacteriological, gaseous, isotopic and radiological parameters by City-, OGS- and privately run labs.

Following each sampling campaign, the City engaged Stantec to develop an ACST for the respective study area. The resulting tools integrated the newly acquired groundwater geochemical data with additional private and publicly available data sets and were informed by a conceptual hydrogeological model tailored to local geological and hydrogeological conditions. Such conditions were surprisingly variable between the 3 rural areas, each of which is faced with specific groundwater quantity and quality issues.

This presentation will provide an overview and update of the study, including the rationale for the ACST, the methods used for well sampling and data integration, and the development of the conceptual hydrogeological model underlying the screening tools. The work demonstrates how high-quality groundwater data, collected through systematic field investigations, can be transformed into practical decision-support products that enhance planning outcomes and help ensure long-term groundwater sustainability for privately serviced properties across rural Ottawa.

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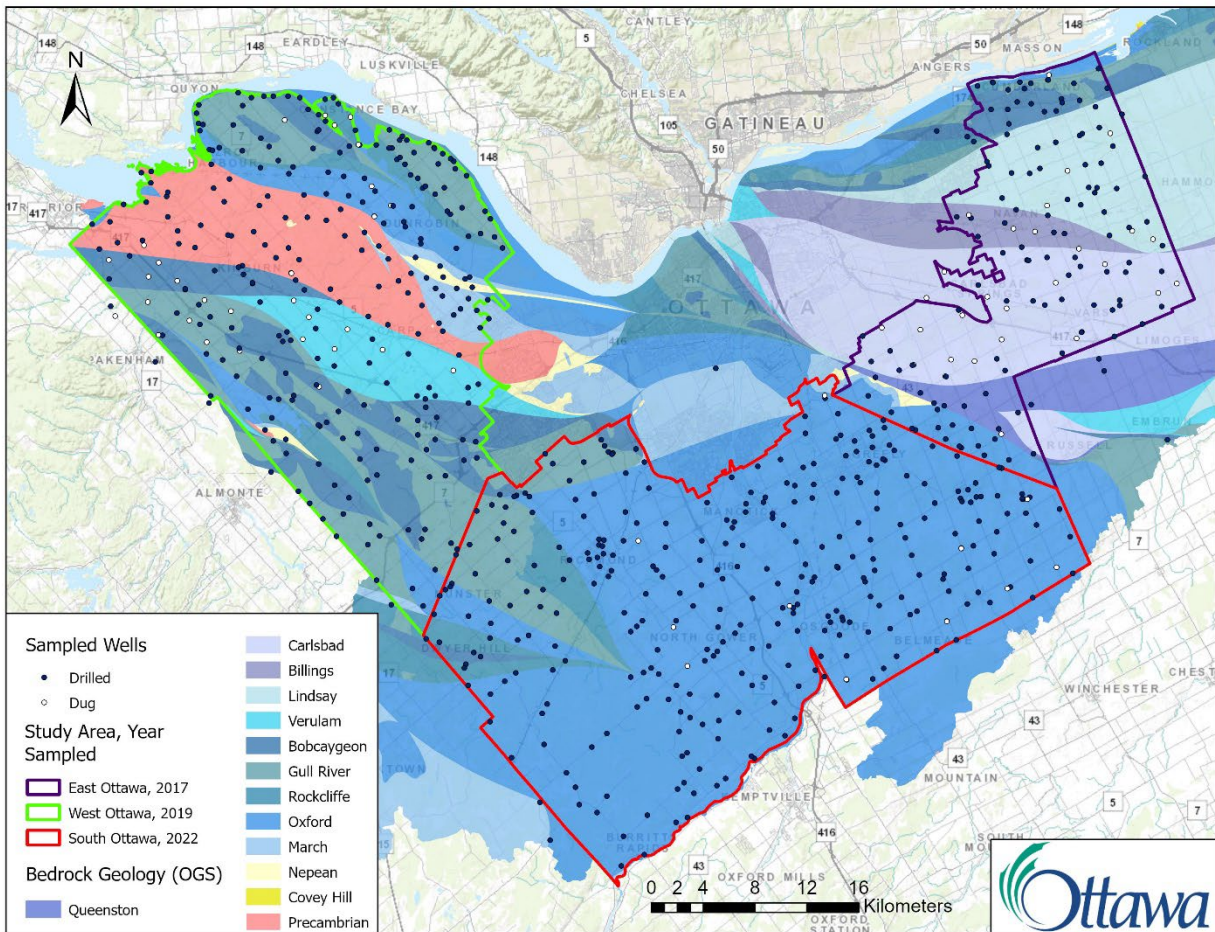


Figure 1. Ottawa groundwater studies: study areas and well sampling locations.

Nutrients: Friend or Foe?

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Nutrients are essential for plant and animal growth and are critical inputs for optimal agricultural production. However, elevated concentrations of nutrients, primarily nitrogen and phosphorus, can result from a variety of point and non-point sources, including wastewater treatment systems, industrial discharges, fertilizers and livestock operations. When nutrient applications are in excess, nutrients can leach below the root zone, impacting both groundwater and surface water quality.

Elevated nutrient concentrations in groundwater systems can impact potable water supplies. They can also impair surface water quality if nutrient-rich groundwater discharges to surface waters via diffuse seepage, springs or via tile drains. Excess nutrients in surface water can result in algal blooms, fish kills and dramatic shifts in ecosystem diversity. Blue-green algal blooms can also produce cyanotoxins, such as microcystin, which are challenging and expensive to remove from drinking water supplies. Municipal drinking water systems were impacted in 2014 in both Toledo, Ohio, and Pelee Island, Ontario, and algal blooms continue to be an issue requiring additional monitoring and enhanced potable water treatment. Therefore, ongoing management and monitoring of both groundwater and surface water nutrient sources and concentrations is essential for the protection of human health and the environment.

This panel discussion will examine the issues and opportunities with respect to impact assessments, monitoring programs, as well as mitigation and remediation options.

Characterizing Nutrient Loading Risk to Surface Water and Groundwater with a Fully Integrated Surface Water–Groundwater Model

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In the Leamington region of southern Ontario, greenhouse discharge into retention ponds poses a nutrient loading risk to both surface water (SW) and groundwater (GW) through drainage, overland flow and infiltration. However, until now this risk has remained largely unquantified. In this project, a fully-integrated SW-GW model is constructed for 460 km² of dense greenhouse landscape that includes Leamington and the surrounding area. The model is subsequently used to quantify SW-GW interactions and transport pathways over a 2017 to 2024 daily-transient simulation interval. The hydrostratigraphy in the model is derived from the Geological Survey of Canada's southern Ontario hydrostratigraphic model and includes 1 bedrock layer, 7 surficial geology layers and 3 soil layers. Land cover in the model incorporates greenhouse footprints, as well as 212 digitized retention pond and wetland features. Spatial resolution of the three-dimensional unstructured finite element mesh that underpins the model ranges from less than 50 m to a maximum of 250 m along surface water features and to a global maximum of 500 m. The model domain extends approximately 1 km into Lake Erie to enable direct tracking of GW discharge into the lake. The model was calibrated against transient surface water flow rates, groundwater heads, and surface water feature expression. Using a recently developed hydraulic mixing cell approach (mass conservative advective transport tracking), transport pathways from the retention ponds are delineated and the cumulative mass loading effect is quantified in the river and stream networks as well as in the GW flow system. Results from the project provide a spatially distributed and temporally varying water balance for the Leamington area, including GW recharge and GW discharge into streams, rivers and Lake Erie, as well as a characterization of potential mass transport pathways for greenhouse-derived nutrients.

Mapping Canada's Groundwater Governance Innovations and Gaps: A Landscape Perspective

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The summer of 2025 has brought new attention to Canada's groundwater challenges. In this context, geoscientists and groundwater professionals have taken growing interest in groundwater governance and policy. Groundwater governance refers to the ways "societies organize themselves to make decisions and take action" (de Loë and Patterson 2017). This broad definition is important because it highlights that the outcomes society cares about—safe drinking water, resilient agriculture, conserving freshwater ecosystems—depend on decisions and actions across a range of scales, jurisdictions and sectors. For example, the newly created Canada Water Agency has convened a freshwater hub with over 20 agencies at the federal level. Federal–provincial–territorial co-ordination has also expanded, including the National Dialogue on Groundwater hosted by Natural Resources Canada and a national private well workshop co-ordinated by Health Canada. The shift from government to governance also reflects the importance of community and private sector and citizen roles in decision-making and implementation, including the nearly two million private well owners and approximately a third of households on reserve relying on private wells or cisterns (Office of the Auditor General 2021).

This presentation maps groundwater governance innovations and gaps in Canada through a landscape perspective. We follow 3 steps. First, we introduce some of the problems that groundwater governance strives to address, including source water protection, groundwater permitting and protecting environmental flows. In the second step, we identify the actors and jurisdictions with an interest in these issues and authority to address them. Finally, we take stock of governance capacity, innovations and gaps, including co-ordination challenges to address fragmentation and ambiguity over jurisdiction. We include a case study of water permitting to illustrate how the landscape perspective can be used as a diagnostic tool. A comparative analysis of groundwater permitting and the management of unlicensed wells reveals a common set of challenges and implementation gaps, as well as innovations and recommendations. For example, regardless of the legal doctrine used by provinces and territories, a common set of challenges exist: mapping aquifers; setting cumulative limits and safeguarding environmental flows; establishing priorities during dry periods; buy-in from users on permitting or licensing, regulating use from unlicensed wells; ensuring adequate monitoring and reporting; setting rates and recovering costs for municipal and industrial water uses. These common challenges depend on growing capacity at the provincial and territorial level, but also key roles at multiple scales. We provide recommendations for strengthening groundwater governance and a framework for assessing progress toward improved capacity and outcomes.

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Paleozoic Mapping Activities in Eastern and South-Central Ontario

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This presentation provides an overview of current Ontario Geological Survey (OGS) Paleozoic mapping activities in eastern and south-central Ontario and introduces proposed changes in formation- and group-rank nomenclature of the Simcoe (central Ontario) and Ottawa (eastern Ontario) groups to Paleozoic bedrock maps (Brunton et al. 2021).

The Simcoe Group (or Ottawa Group) is equivalent to the combined Black River and Trenton groups of the subsurface of southern Ontario. The nature of the Black River–Trenton groups boundary within the Upper Ordovician succession of southern Ontario remains a long-standing stratigraphic challenge. This interval is widely interpreted as a regional disconformity linked to Turinian–Chatfieldian tectonic activity, marking a shift from restricted marine carbonate deposition to an open-marine ramp setting influenced by Appalachian orogenic loading and increased siliciclastic influx. In eastern Ontario, Black River Group sediments were deposited in a broad, low-relief, arid and restricted marine environment that resulted in a variety of lithofacies and lateral heterogeneity. The depositional setting in south-central Ontario was similar; however, there are differences in observed lithofacies, thickness of sediment and general sedimentary architecture. These differences have contributed to geographic inconsistency in how the nomenclature has been applied, and to the challenge of defining the Black River–Trenton groups boundary. Regardless of regional differences in stratigraphy, the disconformable contact between the Black River and Trenton groups is an important surface for groundwater flow. This interval is escarpment forming and, in some cases, heavily karsted (i.e., along the Moira River), but, because of inconsistency in how nomenclature has been applied regionally, the mapped formational contacts do not consistently highlight this important interval. New field mapping, geochemical data, thin section analysis and interpretation of new lidar imagery with an unprecedented level of detail have been integrated into the updated mapping and ultimately will contribute to ongoing revisions to the Paleozoic Lithostratigraphic Chart and any future updates to the three-dimensional (3-D) Leapfrog® Paleozoic bedrock model (Brunton et al. 2017; Carter et al. 2019; Carter et al. 2021).

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An “Aggregate” Approach to Groundwater Resource Management

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Groundwater and aggregates are some of the many essential resources upon which we rely on every single day to maintain modern-day life and infrastructure. The interconnectedness of these 2 resources is critical and, by integrating aggregate data, it would provide a more comprehensive understanding of factors that could influence groundwater levels and quality. In response to the demand for easily accessible and up-to-date information on aggregate resources of Ontario, the Ontario Geological Survey (OGS) released a geographic information systems (GIS)-based aggregate compilation called: *Aggregate Resources of Ontario* (ARO). This compilation is based on data compiled from aggregate resources inventory mapping conducted by the OGS from 1980 to 2025. Most, but not all, data are gathered from Aggregate Resource Inventory Papers (ARIPs) and Open File Reports (OFRs), which were originally published in hard-copy and/or various digital formats and datums. This compilation provides a single source for sand and gravel, buried and drift thickness (or bedrock) provincial mapping data. Although aggregate mapping and assessment is largely geared for land-use planning purposes, it is also a useful source of information for geotechnical or groundwater work. Detailed information on subsurface material type, depth-to-bedrock, material composition and aggregate quality are among some of the key data included in this compilation that could provide insights on suitable groundwater recharge areas. This “aggregate” approach fosters a more comprehensive understanding of resource availability that is essential for sustainable groundwater management practices.

Beneath the Boreal: Update on the Ambient Groundwater Geochemistry Project of the Thunder Bay Area

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The Ambient Groundwater Geochemistry Project (AGGP) is a comprehensive analytical characterization of groundwater geochemistry across all southern Ontario that was initiated in 2007 by the Ontario Geological Survey (OGS). The AGGP expanded to northern Ontario in 2016 to determine if the methods employed by this program could be successful in delineating the effect of Precambrian host rock lithology on groundwater chemistry (Hamilton 2021). The northern Ontario program thus far has been successful in characterizing numerous controls on groundwater chemistry, gaining a better understanding of brine mixing and sources of salinity from various rock units, as well as Quaternary deposit thickness and composition (Dell 2024).

Previous groundwater sampling programs in the Thunder Bay area have documented groundwater quality issues including elevated iron, manganese, chloride and fluoride levels, related to bedrock geology (Puumala 2013, 2008). In the summer of 2024, the OGS conducted a field program sampling 50 overburden and 64 bedrock wells over an area of approximately 3500 km² extending from Kakabeka Falls (west of Thunder Bay) to Navilus (east of Thunder Bay). The objectives of the 2024 sampling program were to further constrain the extent of previously identified groundwater quality issues; examine the possible influence on groundwater chemistry of polymetallic veins, which were historically mined in the area for silver and locally contain higher levels of lead, zinc, cobalt and arsenic (Franklin et al. 1986) and extend AGGP coverage across northern Ontario. This talk will focus on the current status of the project and discuss the next steps.

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Groundwater Management in Ontario: A Look Back – A Look Ahead

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When combined with a moderate climate that is influenced by 3 Great Lakes and its wide variety of soils left behind by the glaciers, Ontario's abundant groundwater resources certainly place south-central Ontario in an enviable position. Especially when considered from a global perspective. A wide variety of crops can be grown, natural forests and green spaces are common, allowing for tourism and recreation to thrive. Our economic prosperity is intricately linked to water resources and, as we are all aware, groundwater is the underappreciated part of the water system.

Recognizing this advantageous position with respect to water resources, Ontario has passed many pieces of legislation aimed at managing and protecting water resources. Water taking permits for large water takings are required to ensure that use is sustainable without negative consequences. Companies and individuals are not allowed to introduce contaminants into lakes, lands and waterways. Planning in Ontario recognizes that urban development be designed and approved in such a way as to maintain hydrologic features and their function. Following on the Walkerton tragedy in 2000, Ontario has passed the *Clean Water Act, 2006* and developed strong legislation and planning to focus on maintaining clean sources of drinking water.

However, Ontario is now experiencing a housing crisis. As a result, there is a rush to approve and build additional housing. Environmental policies and regulations, including those linked to water are taking a back seat as legislation is being adjusted in the hopes of streamlining approvals and costs associated with building more housing, and building it faster.

Whereas transformative speed is today's priority, when it comes to the long-term custodianship of Ontario's water and land, history tells us that caution is needed. Ontario must not embark down an unsustainable path that compromises water and land resources; a path that sees Ontario become less self sufficient in terms of food production, and diminished in terms of natural environment, recreation and tourism.

As we embark down this new path, it is worthwhile to take stock of the previous era and to examine how effective previous efforts have been at managing and protecting water resources. Have policies been too restrictive or too permissive? Have hydrological features and their function been protected, maintained and advanced? Are there monitoring data available to answer such probing questions? The Oak Ridges Moraine Groundwater Program, established in 2001, manages data and information that can help to answer such questions. This talk will explore the efficacy of maintaining a water-related data and information system, and the insights that can be derived from having access to readily available data and interpretations of flow systems.

Potential Fault Control on Fluid Migration in the Shallow Groundwater of the Western Part of the Niagara Peninsula

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A five-year project to assess water resources in the lower part of the Grand River watershed was launched in April 2024. The study area covers approximately 2000 km² and includes the Six Nations and Mississaugas of the Credit First Nation reserves. Locally, the groundwater carries high levels of H₂S. A specific study aims at understanding the source of sulphates leading to H₂S generation. Research on the marine sulphates of the Upper Silurian Salina Group has resulted in the recognition of their critical role for the presence of SO₄²⁻ in groundwater (Lavoie, Hamilton and Rivard, in press). However, in a restricted area (Figure 1), another source of SO₄²⁻ is also involved with anomalous isotopic SO₄²⁻ values (Matheson, Hamilton and Kyser 2018). The terrestrial sulphates of the Ordovician Queenston Formation are proposed as the source of the sulphates (Hamilton and Colgrove, in press), although SO₄²⁻ migration mechanisms are problematic.

The hypothesis of fault-controlled fluid migration is evaluated. The contact between major Grenvillian belts occurs in the Niagara Peninsula (Boyce and Morris 2002). High-resolution aeromagnetic data have located the trace of significant northeast-to-southwest-trending lineaments in the contact zone between the Grenvillian belts roughly matching the limits of the area with anomalous SO₄²⁻ isotopic values (see Figure 1). Seismic lines (Ouassaa, Forsyth and White 2002) have imaged numerous Grenvillian-rooted extensional faults cutting through the Paleozoic units (including the Queenston Formation) with the presence of “seismic sags” in Ordovician–Silurian carbonates indicative of hydrothermal fluid circulation and alteration of the Paleozoic units. The current petrography and geochemistry study seeks evidence of localized anomalous high-temperature events in the organic matter maturation of the Salina Group mudstones and in the dolostones of the Guelph Formation, both of which are present at shallow depths. Regional events of high-temperature fluid events and fault activities are known in the Paleozoic and Mesozoic. Modern earthquake activity in the immediate vicinity of the Niagara Peninsula indicates that the Grenvillian-rooted faults are still active.

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Potential Fault Control on Fluid Migration in the Shallow Groundwater of the Western Part of the Niagara Peninsula (*continued*)

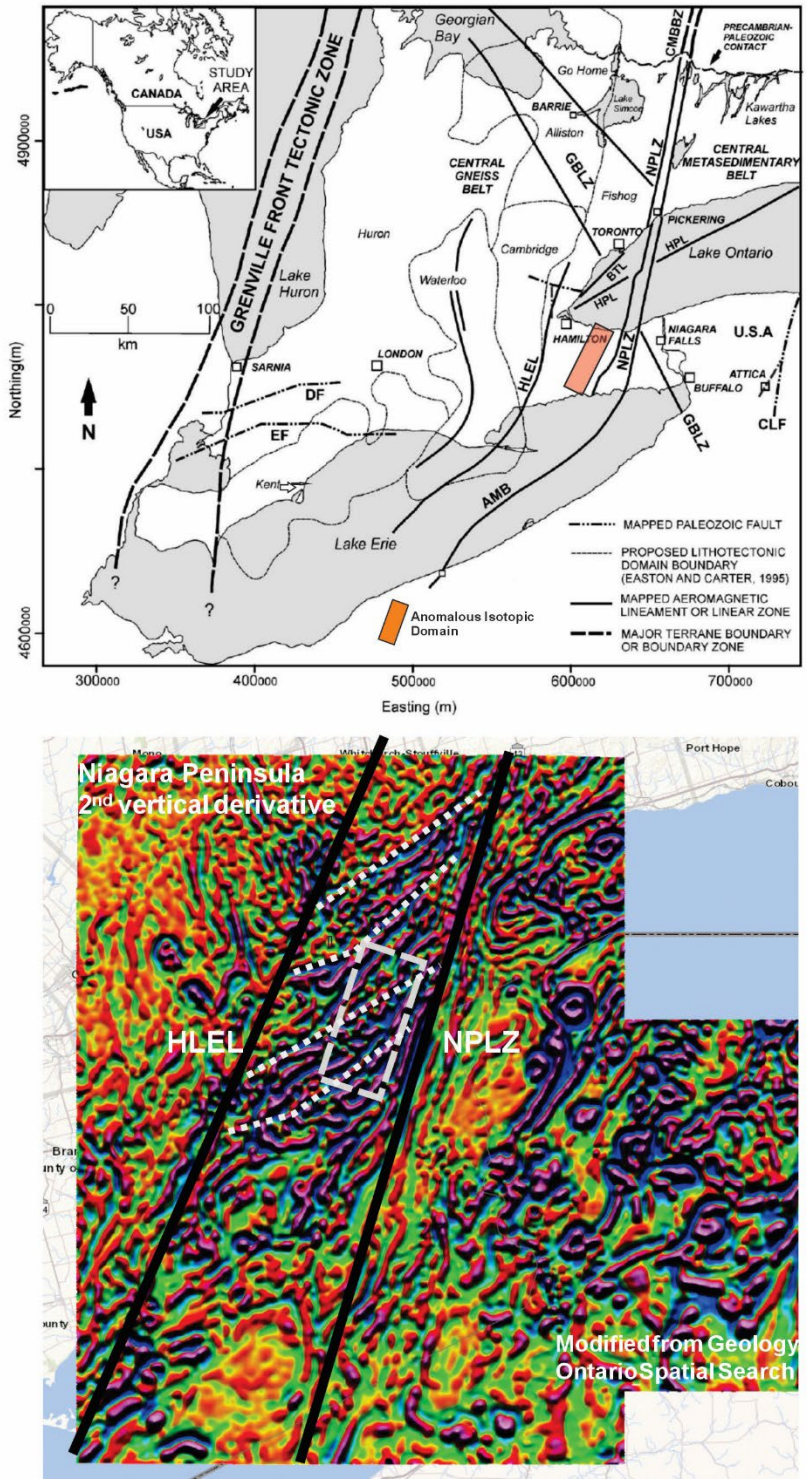


Figure 1. Top) Map of main lineaments marking the limit between the Central Gneiss Belt and Central Metasedimentary Belt in southern Ontario. In orange, anomalous isotopic SO_4^{2-} values in groundwater area. *Modified from Boyce and Morris (2002).* **Bottom)** Second vertical derivative for high-resolution aeromagnetic data in the Niagara Peninsula (*modified from Ontario Geological Survey 2003*). The grey dotted box is the anomalous area. Abbreviations: HLEL: Hamilton–Lake Erie lineament; NPLZ: Niagara–Pickering linear zone. White dotted lines are second-order magnetic lineaments.

The Renewal of the Groundwater Information Network (GIN)

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Aligned with the establishment of scientific and policy recommendations at the national and federal level in the early 2000s (notably, Canadian Framework of Collaboration on Groundwater (Rivera et al. 2003), Standing Senate Committee on Energy, the Environment and Natural Resources (2005) and The Sustainable Management of Groundwater in Canada (2009)), the Geological Survey of Canada (GSC) undertook research and development to develop data exchange standards and establish a platform for integrating groundwater data in Canada. This led to the creation of the Groundwater Markup Language (GWML), a groundwater data exchange standard endorsed by the Open Geospatial Consortium (OGC) and the World Meteorological Organization (WMO), as well as implementation of the groundwater data platform known as the Groundwater Information Network (GIN).

The GIN has the goal to integrate and distribute no less than 15 different types of normalized internal groundwater data from the aquifer assessment projects conducted by the GSC since the early 2000s and to redistribute normalized water wells and groundwater level data from provincial and territorial partners. The data integration capabilities of GIN were also demonstrated on an international level by integrating groundwater data from the United States Geological Survey (USGS).

While the normalization of the data structures is meant to be stable for a long period of time, the technological environment required to support the integration and dissemination of normalized groundwater data is evolving at a much faster speed. The GIN infrastructure built between 2012 and 2019 is aging and not compliant with the latest architectural and IT security requirements defined by the Federal authorities anymore. Consequently, a complete modernization of the GIN platform was initiated in 2023 to bring the architecture and the technology of GIN towards a cloud-based infrastructure. The modernization project presented a remarkable opportunity to redesign the GIN platform to provide the users with a more streamlined and simplified interface while maintaining the access to normalized groundwater data outputs. This presentation will introduce to the audience the new GIN cloud-based architecture and the redesigned interface and will discuss potential future capabilities to support groundwater data integration and data analysis processes.

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The Role of Professional Geoscientists Ontario (PGO): Regulating the Practice of Geoscience in Ontario

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It is easy to see why some professions require regulation: we rely on medical oversight to address malpractice and expect electricians to meet building codes to ensure our safety. Still, the work regulators do to protect the public is often invisible. Even in high-profile fields like healthcare or construction, the public sees only a fraction of what regulatory bodies do behind the scenes.

The same principles of professional oversight apply to geoscience. In Ontario, Professional Geoscientists Ontario (PGO; www.pgo.ca) governs the practice of professional geoscience to protect the public (Ontario 2003). This work centres on 3 core pillars (Figure 1): licensing qualified professionals, upholding standards of practice and ethics, and providing mechanisms for recourse when concerns arise (Ontario 2003, Section 28).

1. Registration

Registering qualified applicants and authorizing companies to practice geoscience in Ontario.

2. Professional Practice

Upholding standards of practice, ethics and professional competence.

3. Complaints, Discipline, and Enforcement & Compliance

Addressing practice concerns involving licensed and unlicensed practitioners.



Figure 1. The 3 core pillars of PGO’s mandate to protect the public.

Through these pillars, PGO helps safeguard responsible and ethical geoscience practice in Ontario with public interest at its core.

The presentation will conclude with a call to action on how practitioners, industry stakeholders and members of the public can engage with PGO’s regulatory tools in order to advance public protection.

This high-level overview aims to build awareness of the regulatory system that governs geoscience in Ontario and to support a shared understanding of the responsibilities that accompany professional practice.

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Investigating Groundwater Flow and Groundwater–Surface Water Interactions Under Climate Change in the Lower Grand River Watershed

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Groundwater is the primary source of drinking water for over 80% of residents in southern Ontario's lower Grand River watershed (2000 km²), which includes 2 First Nations reserves (Grand River Conservation Authority 2025). Residents face persistent water insecurity due to both poor water quality and low aquifer yield (McLaren and Sudicky 1993; Maavara et al. 2018; Kaur et al. 2019; Bernstien 2024). These issues are exacerbated by agricultural intensification, urban expansion and climate change (Irvine et al 2019; Costa, Zhang and Levison 2021) which are transforming recharge patterns and reducing baseflow contributions to surface waters (Jyrkama and Sykes 2007). Despite the ecological and societal importance of groundwater–surface water interactions, discharge processes and overall hydrodynamics in this study area remain poorly characterized due to limited monitoring infrastructure and fragmented data sets.

To date, ThermoChron® iButtons®, fibre-optic distributed temperature sensing cables, current profilers, pressure transducers and surface water loggers have been used to collect high-resolution temperature and hydrometric data. We intend to conduct a survey using a drone-mounted thermal infrared camera this winter. This data set supports a broader Geological Survey of Canada project and simulations to map groundwater discharge zones, quantifying fluxes, and simulating aquifer responses under future climate scenarios. Field investigations include core drilling, monitoring well installation, hydraulic testing and advanced thermal sensing, while geospatial analysis and remote sensing will inform discharge area mapping. Laboratory testing, such as grain size analysis, permeability and porosity of cores, as well as river and well hydrograph interpretation, will further support aquifer characterization.

A conceptual model will be developed based on existing and collected data and validated through integrated numerical simulations using HydroGeoSphere (www.aquanty.com/hydrogeosphere). The project's novelty lies in the integration of emerging thermal sensing technologies with advanced modelling to investigate hydrogeological processes in this study area, which consists primarily of fine-grained surficial sediments and low-permeability substrate. Outcomes will include improved understanding of recharge and discharge dynamics, enhanced predictive capacity under climate stressors, and actionable insights for water resource management. By focussing on a region that mostly comprises poor aquifers yielding mediocre- to low-quality groundwater and 2 Indigenous communities at its centre, this work supports long-term water security and offers a transferable framework for other watersheds facing similar challenges.

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Modelling the Influences of Tile Drain Design on Water Balance and Nutrient Transport in Midwestern Ontario

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Tile drains cover 14% and 45% of the crop land across Canada and southern Ontario, respectively. The benefits of controlled drainage on crop yield and lengthening of growing season is well established; however, the impact on regional water balance and transport of nutrients is poorly defined. An integrated model has been developed using HydroGeoSphere (www.aquanty.com/hydrogeosphere) to illustrate how the design and installation of these subsurface drainage networks interact with the groundwater flow system in terms of both water quantity and quality. The model is based on field data collected within the Main Bayfield watershed conducted at the Huronview Demonstration Farm located in Clinton, Ontario, Canada. The preliminary conceptual model suggesting individual groundwater flow-regimes was developed alongside the geological characterization of the site, in the context of the region's glacial history. An extensive groundwater and tile outflow sampling program was undertaken from 2023 to 2024 for total P, dissolved reactive P and nitrates. The integrated groundwater model uses findings from detailed field investigations to inform its development, including identifications of hydrostratigraphic units, aquifer properties, surface infiltration and soil moisture. The initial watershed model covers an area of 92 km² and will be used to examine existing relationships between water quantity and quality. It will enable the evaluation of predictive scenarios to inform best practices for managing subsurface drainage. Results will benefit tile contractors, farmers, water managers and conservation authorities interested in various tile systems and protection of water quantity and quality.

Diving Down Through the Dirt: Unique Aspects of the Sediment–Bedrock Interface

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Southern Ontario contains a record of at least 2 glacial periods, recorded by stacked successions of tills. Within a groundwater context, these tills are typically treated as regional “leaky” aquitards, but, due to poor data constraint regionally, relatively little consideration is typically paid to the spatial and vertical trends in properties of these tills, and the variations in hydraulic function these properties create.

Surficial studies have recently highlighted areas of intense bedrock erosion and rapid sediment deposition, in the form of “rubble till” and slurry deposits. This subglacial erosion is facilitated by build up of subglacial meltwater pressure, leading to hydrofracturing of the jointed upper bedrock strata, hydraulic jacking of large blocks and rafts, and ripping and subsequent transport by ripping of bedrock slabs or rafts from host rock bodies under glacial shear and comminution. The product of these dynamic processes is a significant increase in fracture density in the upper parts (up to 6 m observed in outcrop) of rock units, and the deposition of a coarse-grained, clast-rich till and stratified sediments composed of almost entirely local bedrock either above the rock mass, or within new or pre-existing fractures. These processes can operate in any setting, above any rock type, but in Ontario, they appear to be most prevalent near Paleozoic bedrock cuestas or the margins of valleys, where rock units have interconnected points of weakness (bedding plane disconformities, joints, and/or faults), and in rock units susceptible to karst dissolution, where weaknesses can be exploited and widened by chemical processes prior to physical erosion by glacial processes.

Landforms and sediment successions produced by these processes can be observed at surface along bedrock cuestas, but equivalent successions were likely formed across much wider areas, likely buried by more recent sediment deposition. We present data from surficial exposures and cored boreholes drilled as part of three-dimensional mapping studies across southern Ontario to highlight the variability in character, thickness and stratigraphy of the sediment–bedrock interface zone across different bedrock lithologies and glacial land systems in southern Ontario. A better understanding on glacial influence on bedrock properties may ultimately lead to improved knowledge of groundwater recharge potential and connection to buried flow systems regionally.

Legacy Log Lithology Linked to Layers: Gathering the Goods for Geoscience and Groundwater Guidance

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This project integrates geological and stratigraphic information for open hole and screened intervals of wells within the Provincial Groundwater Monitoring Network (PGMN) through manual assessment of well records and semi-automated extraction of information from publicly available three-dimensional geological models, where available. Currently, the PGMN consists of 522 wells screened in sediments (n=276), bedrock (n=212) and the interface between (n=12). Wells located on public lands (n=423) are suitable for geological characterization. Geological data are derived from published Ontario Geological Survey (OGS) seamless map data sets, published three-dimensional geological models, and provincial lidar terrain data. For all well locations, we provide new information on surficial material types and regional- to local-scale landforms, as well as characterization of the hydraulic confinement of the water-bearing zones.

Of the bedrock wells, 190 are in Paleozoic strata, commonly in the uppermost formation intersected. Wells are, on average, 17.5 m deep, with 91 wells <9.2 m deep. As a result of the prominence of regional cuestas and increased water-bearing zones therein, bedrock wells are commonly within areas of known (10) or inferred (28) or potential (48) karst conditions and 30 bedrock wells are unconfined, based on information gained from the associated well record. Wells screened in sediments are on average 25.9 m deep, with 74 wells <9.2 m deep. Building on a new province-wide stratigraphic framework currently in development, sediment-hosted wells are screened into 1 of 17 unique Quaternary sediment units that range from unconfined settings (42 wells), partially confined to confined late glacial units (170 wells) and 60 wells are below regional aquitards consisting of last glacial maximum till(s).

By integrating geological and stratigraphic data into the PGMN, an improved context is available for analyzing water level and chemistry trends in individual wells and understanding relationships between wells in different regions.

The Guelph Groundwater Model: Innovation and Collaboration for Effective Water Management

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Guelph is the largest Canadian city to rely almost exclusively on groundwater for its municipal water supply. This supply is drawn from 21 active municipal wells and a shallow groundwater collection system distributed across the City and the Arkell Spring Grounds. For more than a century, groundwater has reliably provided safe drinking water to the community. However, increasing population, land use changes, climate variability, and nearby water takings are placing growing pressure on this water resource. Protecting and managing Guelph's water supply requires a detailed understanding of the regional aquifer system and the factors influencing its resilience now and into the future.

A key tool supporting this work is the Guelph Groundwater Model (Figure 1). This model is an updated version of the 2010 *Guelph, Guelph-Eramosa Tier Three Model* developed through the City of Guelph and Guelph/Eramosa Tier Three Water Budget and Local Area Risk Assessment (Matrix Solutions Inc. 2017) as per the *Clean Water Act, 2006*. Recent updates have significantly enhanced both the conceptual and numerical representation of Quaternary geology across the model domain. Improvements also include the development of an integrated surface water–groundwater flow model using MIKE SHE software, along with updated calibrations to reflect current hydrogeological conditions.

This update was a collaborative effort involving the City of Guelph, Montrose Solutions Inc., and the University of Guelph (supported by a Mitacs grant). It involved the integration of numerous high-quality geological data sets, many of which were generated through Ontario Geological Survey drilling programs, providing critical insights into the Quaternary geology and heterogeneity.

Although the model continues to serve as a vital tool for municipal water resource management, efforts are underway to increase transparency and accessibility. Selected components, such as Leapfrog® scene files, are being prepared for public use, and the full model is being made available to support assessments of potential impacts from water takings within the model domain.

This presentation highlights the technical advancements made to the Guelph Groundwater Model, the collaborative process behind its development, and its role in ensuring the long-term responsible use of the bedrock aquifer for the City's water supply.

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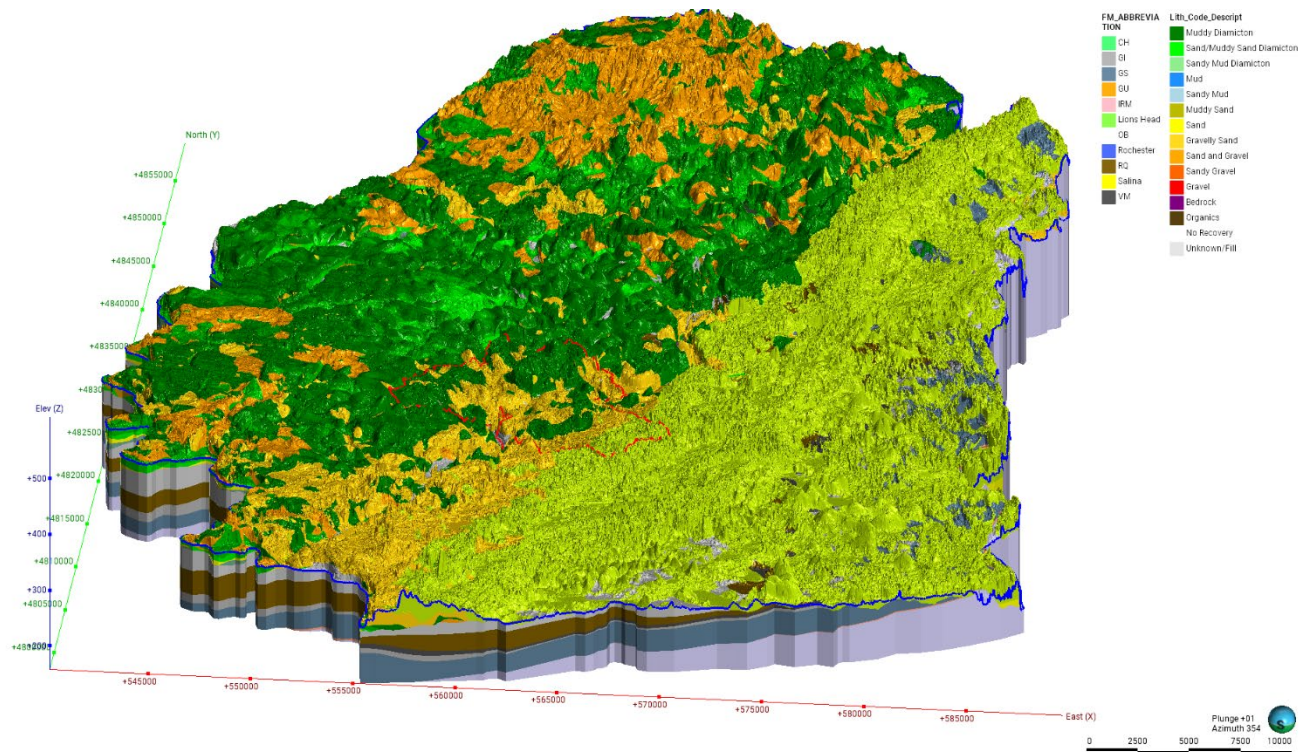


Figure 1. Leapfrog® model of the Guelph Groundwater Model showing a three-dimensional (3-D) perspective bedrock and overburden geology of the model domain.

A Quarter Century of Groundwater Recharge at Milton Quarry

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Comprehensive environmental mitigation has been successfully implemented by Dufferin Aggregates, a CRH Company, for the protection of water resources and related ecological features at the Milton Quarry for more than a quarter century. These mitigation measures include a sophisticated and extensive groundwater recharge well system (GRWS). This unique application of recharge well technology has been used to achieve hydrogeologic mitigation of quarry dewatering effects in a sensitive ecological environment involving groundwater and surface water interactions.

At the Milton Quarry, aggregate resources are extracted from the caprock of the Niagara Escarpment (dolostone of the Amabel/Gasport Formation) and processed to produce a range of high-quality crushed stone products. The same dolostone formation comprises a shallow unconfined aquifer that supports nearby water supply wells, cold water fisheries, and wetlands, including vernal pools used for breeding by the Jefferson Salamander Complex.

The GWRS was conceived, piloted and designed by GHD Limited with the support of Dufferin Aggregates to protect water resources and related ecological features from the quarry dewatering influence associated with planned and proposed extraction below the groundwater table. The GRWS has been fully constructed and operational since 2007 and forms part of an overall water management system comprising a 70 ha reservoir, dedicated pumping station, buried watermains, over 160 recharge wells, and 3 diffuse discharges to wetlands. The 70 ha reservoir forms the backbone of the system and is operated in co-ordination with local agencies to provide resiliency to the watershed during both periods of excess runoff, and during periods of drought.

The GWRS system has been a successful approach to facilitating aggregate extraction in a sensitive environment with well-demonstrated performance of successfully protecting and enhancing water resources and related ecological features. The experience gained from the Milton Quarry has been subsequently applied in support of the extension of the Dufferin Acton Quarry and the recently approved East Extension of the Milton Quarry.

During this session, we will review the history of the site, explore the system from inception to current day, gain an understanding of adaptive management, and review key lessons learned over a quarter century of experience.

Groundwater Project in the Lower Grand River Watershed: 2025 Status of Research

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⁷ Six Nations Polytechnic, 411 Elgin Street, Brantford, ON N3S 7P5

A multi-institutional project focussing on aquifer characterization and groundwater quality was launched in April 2024. The study area corresponds with the lower part of the Grand River watershed (2000 km²) and encompasses 2 First Nations reserves. Much of this area has low yields and mediocre to poor quality groundwater, mainly due to the presence of the Salina Group, a low-permeability evaporitic unit in which groundwater contains salts and various gases. The Quaternary sediment cover is dominated by low-permeability silt and clay and so many residential wells draw water from the interface between the surficial sediments and bedrock, where the latter is most fractured. One of the gases dissolved in groundwater, partly sourced from dissolved sulphates from the Salina Group, is toxic H₂S. Other contaminants affecting groundwater in this region include road salt, nutrients from agriculture, and methane.

In fall 2025, a core drilling campaign was carried out that led to the construction of 9 monitoring wells at 7 sites: 2 wells completed in bedrock (70 and 125 m deep), 1 well screened in a sandy unit and 6 wells completed at the bedrock interface. The cores were lithologically logged and rock samples were selected for geochemical, petrophysical and petrographic analyses, whereas surficial sediment samples were collected for grain size and geochemical analyses. Geophysical logging was performed in most wells, and groundwater samples were collected from all but one, which was dry at the time of sampling. The bedrock wells were sampled at different depths and 2 residential wells were also sampled. Thus, 12 samples were collected for a series of analyses, including anions, metals, and concentrations and isotopes of H₂S, SO₄, CH₄ and strontium.

Two stream/surface water locations have been instrumented and a drone-mounted thermal camera survey will be conducted this winter to study local discharge. In addition, a holistic geological study on the source of abnormal SO₄ isotopic values encountered in a limited area east of the study area (Matheson, Hamilton and Kyser 2018) is underway. Finally, a study on landscape and environmental changes based on interviews with First Nations peoples is ongoing.

Reference

Matheson, E.J., Hamilton, S.M. and Kyser, K. 2018. Shallow groundwater salinization of the Niagara Peninsula, Ontario, Canada; *Geochemistry: Exploration, Environment, Analysis*, v.18, p.155-174.

The Occurrence and Migration of Per- and Polyfluoroalkyl Substances (PFAS) in Landfill Leachate, Groundwater and Drinking Water Wells in Ontario, Canada

► Rodrigues, Luciana¹

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Per- and polyfluoroalkyl substances (PFASs) are synthetic chemicals widely used in industrial processes and consumer products, such as non-stick cookware, stain- and water-resistant clothing, furniture and carpeting, since the 1950s. Their disposal in municipal waste disposal facilities (landfills) has led to widespread environmental contamination globally. Despite their extensive use, PFAS distribution in landfill leachate and groundwater has not been regionally assessed across Ontario, Canada.

This study assesses PFAS in landfill-leachate, groundwater and drinking water from private drinking water wells (domestic wells) at selected 21 Ontario landfills. Sites varied by age, design – natural attenuation (N.A.) or partially engineered (P.E.) – operational status (open or closed), and site conditions. Monitoring focussed on 16 PFAS compounds (total sum denoted as $\sum\text{PFAS}_{16}$). Maximum concentrations of $\sum\text{PFAS}_{16}$ were 1737 ng/L and 10,097 ng/L in N.A. and P.E. landfills, respectively. Six PFAS (PFBA, PFPeA, PFHxA, PFHpA, PFBS and PFOA) were detected in all leachate samples. In 422 groundwater samples, $\sum\text{PFAS}_{16}$ peaked at 6,895 ng/L, with PFBA being the most frequently detected and PFOA being detected at the highest concentration of 2,500 ng/L. To understand the potential for contamination of drinking water, 199 samples from 90 individual domestic wells located approximately 50 m to 1,000 m from landfills' boundaries were analyzed. $\sum\text{PFAS}_{16}$ in drinking water reached 274 ng/L. PFAS profiles in groundwater and drinking water matched nearby landfill sources, confirming offsite plume migration. These findings highlight the need for continued monitoring.

Canada and Groundwater Level Monitoring Networks: Taking Stock from an International and Provincial Context

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Monitoring of the water cycle is conducted for numerous components (climate, soil moisture, surface water, groundwater, etc.) for various objectives, at a range of scales, and by various operators. Canada has a National Hydrometric Service (NHS) that supports water management decisions that help protect Canadians and ecosystems by monitoring surface water flows; however, there is no comparable national program for groundwater. Monitoring networks generally address 2 objectives: water quantity and water quality. Here we focus on groundwater quantity, specifically long-term groundwater level change under natural conditions. Groundwater monitoring in Canada currently exists at local to provincial scales, with variable and inconsistent documentation and accessibility. Through the Groundwater Information Network (GIN), there is an initial national information system, a “network of networks”, delivering access to provincial monitoring data. Fundamental questions still remain: Who contributes to and governs a national groundwater monitoring network? What variables should be measured? When and where should monitoring occur? Why is monitoring needed, and how should it be implemented? Are there lessons to be learned from surface water monitoring such as concurrent quantity and quality? These questions are longstanding. Regional and provincial groundwater monitoring networks were initiated in the 1960s. Work toward a national groundwater monitoring network was initiated in the 1960s by the Geological Survey of Canada, and subsequently Energy Mines and Resources, and further examined in the 1970s by Environment Canada. In the 1980s, the National Water Policy and subsequent reviews recommended groundwater monitoring. As with much of the 1980s water policy, lack of funding and inadequate expertise in government resulted in a lack of attention and focus on groundwater. In the early 2000s, national workshops and reports highlighted the monitoring gap and need to improve groundwater monitoring. More recently, Earth Observation methods and numeric modelling approaches now provide opportunities to merge synoptic-scale assessments with local observations, enabling forecasting and national-scale water resource evaluations. A review of international groundwater monitoring networks is provided to understand where Canada is relative to similar scientifically advanced nations. This review will help inform what a Canadian monitoring network should look like in the 21st century.

Discovering 135 Years of Geoscience Data in Ontario

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GeologyOntario is the authoritative online platform managed by the Ontario Geological Survey (OGS), Ministry of Energy and Mines (MEM), which provides access to Ontario's public geoscience data. It offers a wide range of tools and data sets for professionals, researchers and the public. You can access GeologyOntario through its homepage at www.hub.geologyontario.mines.gov.on.ca and www.platforme.geologyontario.mines.gov.on.ca.

Did you know we have over 10,000 maps, 3,300 reports and 660 digital data sets in GeologyOntario? Join us for a quick lightning talk as we showcase the 135 years of Ontario Geological Survey and how you can discover OGS geoscience data yourself. We will provide a quick preview highlighting updates coming to the GeologyOntario Hub pages over the next few months. This includes adding page navigation as well as standard headers and footers with the goal of building more accessible mobile-friendly pages and applications. New content will include new topic pages, as well as easy to use apps and maps.

Methods for Sampling Nitrate During a Storm Event – Successes and Limitations

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Elevated nitrate concentrations in groundwater and surface water are detrimental for environmental and human health and thus are often monitored. However, collecting reliable spatiotemporal data sets can be difficult in open systems subject to constant change—as is the case in many environmental monitoring situations. Additionally, understanding contaminant transport mechanisms, such as the impact of intense rain events, is critical for developing mitigation strategies. The study objective was to contextualize storm event responses by investigating hydraulic and nutrient dynamics in a sand plain aquifer system. The Lower Whitemans Creek (LWC) subcatchment, located in the Grand River watershed in the Laurentian Great Lakes Basin (north of Lake Erie in Ontario, Canada), including a field scale site, was instrumented to measure nitrate concentrations and field parameters in groundwater and surface water. Frequency of sampling varied from monthly sampling across LWC (October 2021 to November 2024) to targeted rain events using an ISCO autosampler (November 2022 and March 2023) to using higher frequency SUNA and EXO sondes (at varying times during October 2022 to November 2024). The results showed that small, groundwater-fed creeks may be notable contributors of nitrate to the elevated levels in Whitemans Creek. Highlighted are the methods used for storm event sampling along with the advantages and limitations of each approach. The LWC study underscores the benefits of *in-situ* sampling while noting the complications to guide future research related to nitrogen quantification. Additional details on this study can be found in Zeuner, Levison and Larocque (2025).

Reference

Zeuner, C., Levison, J. and Larocque, M. 2025. Insights on nitrate transport in a shallow, sandy aquifer at various temporal and spatial scales; *Frontiers in Environmental Science*, v.13, article 1641345. doi.org/10.3389/fenvs.2025.1641345

Poster Presentations

The following abstracts are included in the oral presentation section because they will be presented as ***Student Spotlights***.

Investigating Groundwater Flow and Groundwater–Surface Water Interactions Under Climate Change in the Lower Grand River Watershed

► Momin, Hafsa; Jana Levison, Christine Rivard and Steven K. Frey

Modelling the Influences of Tile Drain Design on Water Balance and Nutrient Transport in Midwestern Ontario

► Mulkerns, Lauren; Jana Levison, Colby Steelman and Emmanuelle Arnaud

Water Resource Data Availability for Isolated First Nation Communities and Watersheds in Treaty 9

► Dixon-Bolen, Braeden¹; and Randy L. Stotler¹

¹ Department of Earth and Environmental Sciences, University of Waterloo, 200 University Avenue West, Waterloo, ON N2L 3G1

Clean water is essential to community health, yet many Indigenous communities in Canada, particularly those in Treaty 9 (Figure 1), face challenges in water quality monitoring and access. In these isolated regions, water data are often collected following crises, rather than through sustained and proactive efforts. The lack of baseline data contributes to health risks and limits communities' ability to advocate for their rights and environmental protection. Since mining is a prominent subject within the scope of Treaty 9 due to the "Ring of Fire", it is important to identify the current state of the data available within the Treaty. This research investigates water resource data availability in isolated First Nation communities located in northwestern Ontario within Treaty 9 and the watersheds in which they are situated. Guided by cultural teachings and Indigenous data sovereignty, the project uses a two-eyed seeing approach to integrate Indigenous and Western knowledge systems. In consideration of respecting Indigenous data sovereignty, this research will only include collecting the qualitative data types utilized by the communities (e.g., stream gauging), not to obtain the quantitative data. By profiling water data availability for these isolated communities, the goal of this study is to identify gaps in monitoring, providing the information needed to advocate for more resources. The findings will develop information to support sustainable water management practices and strengthen environmental accountability, especially in the context of mining development under Ontario's *Mining Act*.

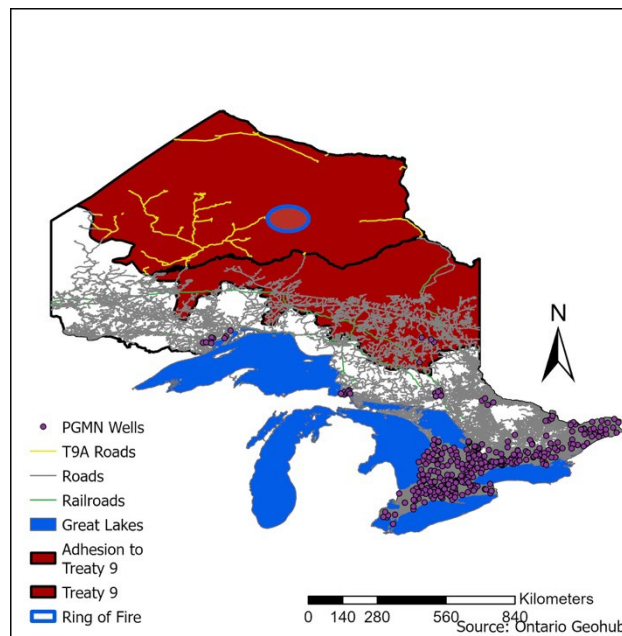


Figure 1. Map of the Treaty 9 area in northern Ontario, distinguishing the area of the Adhesion of Treaty 9 (upper) and the original Treaty 9 boundaries (lower). Also shown are major transportation networks (roads in gray, Adhesion to Treaty 9 roads in yellow, railroads in green), the location of the "Ring of Fire" (blue circle), the locations of the Provincial Groundwater Monitoring Network (PGMN) wells (purple dots), and the Great Lakes (dark blue). Map created by the authors using data sourced from the Ontario Geohub.

Identifying Groundwater Contributions to Streamflow During Winter Within the Alder Creek Watershed

► Forte, Michael J.¹; and Randy L. Stotler¹

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Groundwater–surface water interactions (GWSWI) are one central aspect for understanding effective water resource management, especially in regions dependent on groundwater for the majority of the drinking water supply. However, integrating groundwater–surface water–based approaches to identify these interactions remains a large challenge due to a persistent knowledge gap caused by technological limitations, system complexities and data constraints. Currently, there exists a lack of regional-scale data to represent medium-sized watersheds in southern Ontario, restraining the ability to accurately manage and develop strategies to optimize water resources (Wiebe and Rudolph 2022). Thus, stable isotopes provide a novel option to investigate GWSWI through their preferential movement in the natural environment by categorizing field samples (Stotler 2020).

This study examines the Alder Creek watershed, located on the Waterloo Moraine, to identify groundwater contributions to streamflow and improve the understanding of groundwater–surface water interactions in the area. Using stable isotopes of $\delta^{18}\text{O}$ and δD and electrical conductivity as natural tracers of water movement, this study presents a regional-sized synoptic survey approach to provide a spatially and temporally broad view of the stable isotopes within the watershed. This technique provides a regional basis for which groundwater–surface water interactions can be identified through spatial and timely differences in the measured parameters.

The measured tracers revealed a predominant seasonal meteoric influence on observed isotopic values, indicating the importance of regional precipitation inputs to groundwater recharge. Spatial and temporal variations highlight the effect of hydrological interactions on the watershed on a broad scale, reflecting the relationships between anthropogenic influences from road salt and groundwater contributions to streamflow downstream. Altogether, the samples of isotopes and electrical conductivity underscore the watershed's complex hydrological relationships, emphasizing the need for a more detailed and robust framework to evaluate and address future regional water-related problems, while optimizing water resource management strategies.

References

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- Wiebe, A. J. and Rudolph, D. L. 2022. Meteorological and hydrological data from the Alder Creek watershed, SW Ontario; Earth System Science Data, v.14, no.7, p.3229-3248. doi.org/10.5194/essd-14-3229-2022

Assessment of Direct Groundwater Discharge to Nearshore Waters Along the Northwestern Shoreline of Lake Ontario

► Kings, Meghan A.¹; James W. Roy^{1,2}, Christopher Power¹, Kayla Bruce² and Clare E. Robinson^{1,2}

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The role of lacustrine, or direct, groundwater discharge (LGD) in transporting anthropogenic pollutants (e.g., chloride, nitrogen, phosphorus) into nearshore waters of the Great Lakes is poorly characterized, although its contribution may be important in some areas. Lacustrine groundwater discharge can be challenging to quantify as it tends to be spatially and temporally heterogeneous and this contributes to uncertainty in its measurement and prediction. The objective of this study was to identify hot spots of high LGD along the northwestern shoreline of Lake Ontario in the Greater Toronto Area, as needed to inform a larger investigation assessing the contribution of LGD to salinization of nearshore waters. To address this, radon-222 (²²²Rn) boat surveys were conducted along select shorelines between Burlington and Pickering in the warmer months in 2024 and 2025. ²²²Rn is a widely used, naturally occurring tracer for quantifying groundwater discharge to surface waters (e.g., Wallace, Ji and Robinson 2020).

Overall, surveys found relatively low in-lake ²²²Rn concentrations (≤ 35 Bq/m³) in nearshore waters, with the highest concentrations observed at Scarborough Bluffs and Frenchman's Bay. Maximum in-lake ²²²Rn concentrations were lower than those observed in other large lakes, including Lake Simcoe and Lake Huron (Wallace, Ji and Robinson 2020; Ji et al. 2017), possibly suggesting lower LGD in the surveyed areas. These results may be due to thin Quaternary overburden thickness along most of the surveyed area (Gao et al. 2006), although further investigation is needed to evaluate the hydrogeological controls on the magnitude of nearshore LGD. Future work includes a comparative analysis between the hydrogeological conditions near the Lake Ontario shoreline relative to other large glacial lakes for which nearshore LGD has been quantified. The study findings are needed to understand the potential contribution of LGD in delivering anthropogenic pollutants to the nearshore waters of Lake Ontario and, thus, to inform future water quality monitoring and management efforts.

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Hidden Connections: How Groundwater–Surface Water Interactions Shape Chloride Dynamics in an Urban Stream

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Urban streams across the Great Lakes Basin are experiencing chronic chloride (Cl⁻) enrichment, primarily due to extensive road salt application. While winter runoff is a well-recognized source, less attention has been given to the slow and persistent contribution of Cl⁻ from groundwater. This study (Mackie et al. 2026) investigates how groundwater–surface water (GW–SW) interactions influence in-stream Cl⁻ dynamics in a highly urbanized subwatershed along the north shore of Lake Ontario in southern Ontario, Canada. Over a two-year field campaign (May 2022–April 2024), multiple complementary techniques were used to assess spatial and temporal patterns of GW–SW exchange. Streambed temperature mapping and vertical thermal profiles identified zones of upward groundwater flow, supported by hydraulic gradients and seepage meter measurements. Stable isotopes of water and Cl⁻ concentrations were used to evaluate mixing between surface and groundwater sources.

Results indicate that groundwater discharge is spatially variable but persistent, contributing to elevated Cl⁻ concentrations even during non-winter months. Shallow groundwater in discharge areas reflects elevated Cl⁻ from anthropogenic sources (road salt, landfill leachate), whereas deeper groundwater exhibits naturally higher background Cl⁻ (Lackey et al., submitted). Topography-driven hyporheic flows and mixing between these groundwater sources further enhance Cl⁻ levels locally, such that surface water and streambed piezometer concentrations consistently exceed aquatic life guidelines (long-term – 120 mg/L; short-term – 640 mg/L). Overall, these results highlight the year-round influence of groundwater contributions on stream salinization and the role of groundwater as a long-term Cl⁻ reservoir, maintaining elevated stream salinity long after winter applications of road salts cease. By integrating thermal, hydraulic and geochemical methods, this study demonstrates how field-based tools can be combined to visualize and quantify GW–SW exchange and associated Cl⁻ transport. The results provide valuable insight for urban watershed management and Cl⁻ reduction strategies, particularly in temperate cold-region environments where subsurface contributions are commonly overlooked.

References

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Role of Subsurface Drainage Infrastructure as a Pathway for Wastewater Contaminants to Reach Streams from On-Site Wastewater Treatment Systems

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On-site wastewater treatment systems (OWTSs; e.g., septic systems) are widely used globally, including by approximately 14% of Canadian households (Canada 2025, and references therein) for domestic wastewater treatment and dispersal. Many wastewater contaminants that degrade surface water quality include fecal contaminants (e.g., bacteria and viruses), nutrients (nitrogen (N) and phosphorus (P)), and emerging contaminants (e.g., pharmaceuticals, microplastics, per- and polyfluoroalkylated substances (PFAS)). When OWTSs are functioning properly, many of these contaminants undergo high attenuation in the unsaturated zone within and below OWTS drainage beds, thereby reducing groundwater and surface water contamination. However, due to poor design, installation and maintenance practices, including placement of OWTS in unsuitable locations (e.g., areas with a high water table), contaminants may be short-circuited to surface waters via pathways including subsurface drainage infrastructure.

The objective of this study is to determine the importance of shallow drainage infrastructure in residential and agricultural areas in intercepting subsurface OWTS contaminant plumes and facilitating more rapid delivery of contaminants to streams. This objective was assessed by sampling residential, storm sewer, relic (old or of unknown use), and agricultural drains discharging to streams within subwatersheds across the Lake Erie Basin. Samples were analyzed for a suite of wastewater constituents, including conventional indicators: soluble reactive phosphorus, nitrate, *E. coli* and chloride, as well as more advanced human-specific wastewater tracers: artificial sweeteners and the human-specific microbial DNA marker HF183. Data revealed elevated, yet variable, concentrations and loads of human wastewater tracers across all drain types, suggesting that each type may act as important conduits for delivering wastewater contaminants to streams. Current data analysis includes evaluating the influence of factors, such as overburden permeability, average house age and topographic wetness indicator, on the prevalence of drains impacted by OWTS contaminants. The study findings highlight the need to consider subsurface drainage infrastructure as a preferential pathway for OWTS-derived wastewater contaminants to surface waters when designing, siting and re-inspecting OWTSs.

Reference

Canada 2025. Municipal wastewater treatment; Environment and Climate Change Canada, www.canada.ca/en/environment-climate-change/services/environmental-indicators/municipal-wastewater-treatment.html. [accessed February 15, 2026]

A Coupled Hydro-Economic Modelling Framework for Sustainable Groundwater Irrigation: Insights and Applications Relevant to Ontario Agriculture

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This research develops an integrated hydro-economic modelling framework to support farm-level irrigation decisions under hydrologic, economic and climatic uncertainty. The model couples groundwater dynamics, crop yield response, and economic valuation to assess trade-offs between agricultural profitability, water use, and long-term aquifer sustainability. Conditional Value-at-Risk (CVaR) is incorporated to evaluate downside risk and capture extreme events often overlooked by traditional risk assessment methods. Although the framework is demonstrated using 2 contrasting systems: the High Plains Aquifer (United States) and the Saskatchewan River Basin (Canada), the methods and insights can directly transfer to groundwater-dependent agricultural regions in Ontario, where farmers and stakeholders also face pressures from variable climate, limited water supplies, and competing demands. Results show that moderate pumping strategies can balance profitability with groundwater sustainability, whereas excessive withdrawals reduce long-term benefits and potential impacts on connected water bodies. Multi-objective optimization (NSGA-II) further identifies trade-offs among land value, groundwater levels, and streamflow depletion that can guide policy and farm management. Overall, this adaptable and data-efficient framework offers a practical decision-support tool that can be applied to Ontario agricultural settings, contributing to sustainable groundwater irrigation management under increasing climate and market variability.

Identification of Groundwater Salt Plumes Along the Highly Urbanized Lake Ontario Shoreline Using Geophysical Techniques

► **Zhu, Junwei¹; Christopher Power¹, James W. Roy^{1,2} and Clare E. Robinson¹**

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Increasing chloride (Cl) concentrations in urban groundwater and surface waters caused by winter de-icing salt applications poses growing challenges to drinking water supplies and aquatic ecosystems. Although recent studies highlight the important role of groundwater discharge in stream salinization, the contribution of direct groundwater discharge to the salinization of nearshore waters of the Great Lakes, particularly along urban shorelines, is unclear. The objective of this study was to identify groundwater salt plumes along the Lake Ontario shoreline in the Greater Toronto Area that may be discharging into nearshore waters. This was addressed by first conducting electromagnetic induction (EMI) surveys along 27 shoreline areas between Burlington and Scarborough to identify areas with potentially elevated groundwater salt concentrations. Detailed field investigations were then conducted along 2 shoreline areas, Sunnyside Beach and Bluffer's Park Beach, which were identified from the EMI surveys as potential hotspots for groundwater salt contamination. At these 2 sites, three-dimensional electrical resistivity tomography (3-D ERT) surveys and passive seismic horizontal-to-vertical spectral ratio (HVSr) tests were performed together with shallow (<2 m) groundwater and sediment sampling and horizontal hydraulic gradient measurements to characterize the shallow lithology and groundwater salt plumes that may be discharging to the lake. The 3-D ERT surveys detected high salt concentrations in the shallow subsurface (up to 8 m depth) along Sunnyside Beach. The presence of these high-concentration salt plumes was confirmed through groundwater sampling, which showed electrical conductivity (EC) and Cl concentrations reaching up to 8070 mS/cm and 2310 mg/L, respectively. Groundwater salt plumes were also present along Bluffer's Park Beach (up to 7.3 m depth), though the shallow groundwater EC and Cl concentrations only reached 1810 mS/cm and 553 mg/L, respectively, in this area. The Cl concentrations estimated from ERT measurements were well correlated ($R^2 = 0.83$) with the lab-measured Cl concentrations, validating our interpretation of ERT survey results. Finally, passive seismic HVSr data were valuable in supporting the interpretation of the 3-D ERT data by providing estimates of unconsolidated overburden thickness along the study shorelines. Future work will evaluate seasonal changes in groundwater salt inputs to the nearshore waters by time-lapse ERT surveys combined with continuous groundwater-level measurements. This study provides new information on the potential contribution of direct groundwater discharge to lake salinization and demonstrates the benefits of using rapid non-invasive geophysical techniques to identify and characterize high salt plumes discharging to nearshore waters of the Great Lakes.

Booth Descriptions



The Role of Professional Geoscientists Ontario (PGO): Regulating the Practice of Geoscience in Ontario

► **Atmore, Lauren¹; Melanie Siewert¹, Gabrielle Hosein¹ and Marilen Miguel¹**

¹ *Professional Geoscientists Ontario, 155 University Avenue, Suite 302, Toronto, ON M5H 2B7*

Professional Geoscientists Ontario is the licensing and regulatory body responsible for Ontario's geoscientists. Our mandate is to serve and protect the public interest by governing the practice of professional geoscience in Ontario. To accomplish this, the Province of Ontario has entrusted PGO with the responsibility to register geoscientists, admit only qualified persons who pass standards of knowledge and experience, maintain standards of practice and ethics, respond to complaints concerning our registrants, discipline when necessary and encourage continuing professional competence.

This event presents PGO with a meaningful opportunity to engage with the geoscience community in the central and southwest regions of Ontario. PGO's presence supports attendees in understanding the regulatory framework that governs the practice of geoscience. PGO staff will be on-site to speak one-on-one with the event attendees.

To encourage engagement, we'll feature information on

- Pathways to registration, professional practice, and mechanisms for accountability
- Continuing professional development opportunities
- Different ways to contribute to PGO's public protection mandate
- Virtual Mentoring Program
- Professional practice guidelines and other key resources

Well-Known Aquifers: A 3-D View of the Oak Ridges Moraine

► Clark, Jordan K.¹; Connor MacLeod¹ and Matthew Dupont¹

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Pull apart the Oak Ridges Moraine in a new three-dimensional (3-D) printed model. From the Geological Survey of Canada's Open File 9165 data (Logan et al. 2024), this is a scaled clip of the Oak Ridges Moraine area. The tactile model displays key sediment units as they drape across the landscape, revealing the geometry of the moraine. The Oak Ridges Moraine is well known as a regional recharge area, but it is also part of a broader Quaternary system that is critical to groundwater in southern Ontario.

This display from the Oil, Gas and Salt Resources Library (OGSR Library) also features models representing the lithological and hydrogeologic stratigraphy of southwestern Ontario. These deeper layers are important controls on bedrock groundwater systems. Models are available to explore in multiple media, from tactile 3-D prints to fully immersive virtual-reality experiences.

The OGSR Library warehouses thousands of rock chip samples and cores from Paleozoic bedrock wells across Ontario. Knowing the subsurface well through an extensive sample and file catalogue enabled our partners to turn technical borehole data into clear visuals, making aquifers easier to share, study and explain.

With thanks to our partners: Geological Survey of Canada, Ontario Geological Survey, and Ontario Ministry of Natural Resources.

Reference

Logan, C.E., Russell, H.A.J., Burt, A.K., Mulligan, R.P.M., Sharpe, D.R. and Bajc, A.F. 2024. A three-dimensional surficial geology model of southern Ontario; Geological Survey of Canada, Open File 9165, 37p. doi.org/10.4095/pudw24j7x

IAH Canada – Your National Organization

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Groundwater is a critical natural resource, comprising 80% of Canada's fresh water. It is the source of drinking water for almost one third of Canadians and supports the baseflow of nearly every surface water body. Despite these critical roles, groundwater science is consistently underrepresented in national water issues and discussions.

IAH Canada is a branch of the International Association of Hydrogeologists (IAH), a worldwide scientific and educational organization that exists to promote the study, knowledge and application of hydrogeological science. IAH Canada currently represents approximately 400 professionals across Canada. We are an active organization that offers members a variety of talks, seminars, webinars, networking opportunities, and conferences. Specifically, the Committee for Groundwater Advocacy focusses on 4 priority areas: targeted advocacy, public communications, event participation, and policy review. Engagements with senior leaders at the Canada Water Agency, Natural Resources Canada, and Environment and Climate Change Canada have informed the Freshwater Data Strategy and National Freshwater Science Agenda. Members have amplified groundwater's profile at key events, including the National Dialogue on Groundwater, Ontario Groundwater Geoscience Open House, BC Groundwater Science Symposium, and the annual IAH Canada conference. The Committee is also contributing to a national groundwater policy review led by Blue Range Labs.

Through these efforts, IAH Canada is building momentum toward sustained national groundwater advocacy and impact. This work builds on early milestones, including a 2024 survey of federal, provincial and territorial government staff on groundwater priorities and the submission of a parliamentary brief to the House of Commons Standing Committee on Environment and Sustainable Development. We welcome all hydrogeologists, scientists, engineers and others who have an interest in groundwater resources, to join and support our organization and the Committee for Groundwater Advocacy.

Enabling Future-Ready Geoscientists and Geological Engineers

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How do university students become future ready? With an evolving learning framework that continually considers the learner, available data, tools and approaches, and professional practice. Here we present updates about our holistic university learning framework providing foundational knowledge and skills to understand southern Ontario's geology. Spatial, temporal, field and system geoscience perspectives were explored that integrated learning experiences with well logs, cross sections, correlation charts, 2-D maps, 3-D digital and print models and field trips. We also present results of a pilot study where Waterloo students articulated skills gained from classroom, lab and field experiences and made connections to Waterloo's Future Ready Talent Framework. This collaboration with the University of Waterloo's Co-operative & Experiential Education team helped students translate their academic experiences and skills into language of achievements valued by employers.

University of Waterloo Earth Sciences Museum

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The Earth Sciences Museum aspires to foster in visitors an appreciation and understanding of the Earth's environments, materials and processes, while facilitating awareness of the intricate human connections to them. Staff will present hands-on examples of learning opportunities offered through programs, as well as summer camp information.

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Having trouble finding OGS data for your study area? A booth will be set up on Tuesday for the in-person event. Please join us for live demos, ask questions relating to the site, or provide suggestions and feedback as we continue to improve GeologyOntario. As we continue to improve the web site, please check back often to see the new feature updates and data sets. You can access GeologyOntario through its homepage at www.hub.geologyontario.mines.gov.on.ca and www.platforme.geologyontario.mines.gov.on.ca.

In GeologyOntario, web services (ArcGIS REST) are available for our pan-provincial data sets including

- Aggregate Resources of Ontario ([ARO](#), [ArcGIS REST](#))
- Physiography ([MRD228](#), [ArcGIS REST](#))
- Surficial Geology ([MRD128-REV](#), [ArcGIS REST](#))
- Karst ([GRS005](#), [ArcGIS REST](#))
- Paleozoic Geology ([MRD219](#), [ArcGIS REST](#))

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Metric Conversion Table

Conversion from SI to Imperial			Conversion from Imperial to SI		
<i>SI Unit</i>	<i>Multiplied by</i>	<i>Gives</i>	<i>Imperial Unit</i>	<i>Multiplied by</i>	<i>Gives</i>
LENGTH					
1 mm	0.039 37	inches	1 inch	25.4	mm
1 cm	0.393 70	inches	1 inch	2.54	cm
1 m	3.280 84	feet	1 foot	0.304 8	m
1 m	0.049 709	chains	1 chain	20.116 8	m
1 km	0.621 371	miles (statute)	1 mile (statute)	1.609 344	km
AREA					
1 cm ²	0.155 0	square inches	1 square inch	6.451 6	cm ²
1 m ²	10.763 9	square feet	1 square foot	0.092 903 04	m ²
1 km ²	0.386 10	square miles	1 square mile	2.589 988	km ²
1 ha	2.471 054	acres	1 acre	0.404 685 6	ha
VOLUME					
1 cm ³	0.061 023	cubic inches	1 cubic inch	16.387 064	cm ³
1 m ³	35.314 7	cubic feet	1 cubic foot	0.028 316 85	m ³
1 m ³	1.307 951	cubic yards	1 cubic yard	0.764 554 86	m ³
CAPACITY					
1 L	1.759 755	pints	1 pint	0.568 261	L
1 L	0.879 877	quarts	1 quart	1.136 522	L
1 L	0.219 969	gallons	1 gallon	4.546 090	L
MASS					
1 g	0.035 273 962	ounces (avdp)	1 ounce (avdp)	28.349 523	g
1 g	0.032 150 747	ounces (troy)	1 ounce (troy)	31.103 476 8	g
1 kg	2.204 622 6	pounds (avdp)	1 pound (avdp)	0.453 592 37	kg
1 kg	0.001 102 3	tons (short)	1 ton(short)	907.184 74	kg
1 t	1.102 311 3	tons (short)	1 ton (short)	0.907 184 74	t
1 kg	0.000 984 21	tons (long)	1 ton (long)	1016.046 908 8	kg
1 t	0.984 206 5	tons (long)	1 ton (long)	1.016 046 9	t
CONCENTRATION					
1 g/t	0.029 166 6	ounce (troy) / ton (short)	1 ounce (troy) / ton (short)	34.285 714 2	g/t
1 g/t	0.583 333 33	pennyweights / ton (short)	1 pennyweight / ton (short)	1.714 285 7	g/t

OTHER USEFUL CONVERSION FACTORS

	<i>Multiplied by</i>	
1 ounce (troy) per ton (short)	31.103 477	grams per ton (short)
1 gram per ton (short)	0.032 151	ounces (troy) per ton (short)
1 ounce (troy) per ton (short)	20.0	pennyweights per ton (short)
1 pennyweight per ton (short)	0.05	ounces (troy) per ton (short)

*Note: Conversion factors in **bold** type are exact. The conversion factors have been taken from or have been derived from factors given in the Metric Practice Guide for the Canadian Mining and Metallurgical Industries, published by the Mining Association of Canada in co-operation with the Coal Association of Canada.*

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