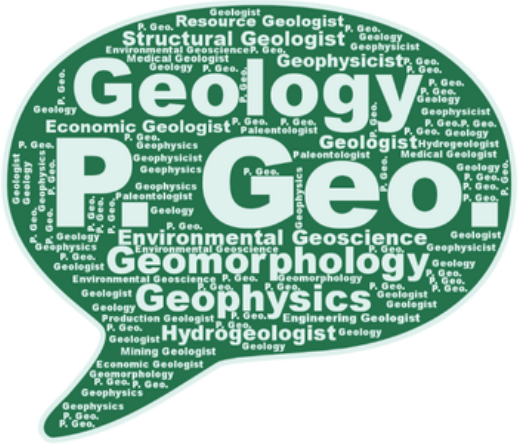
Siccar Point, Scotland. Considered to be the birthplace of modern geoscience, the place where Hutton, Playfair and Hall determined that the Earth must be far older than the accepted dogma at the time. These early works and those that followed were part of a new public enlightenment about the importance of deep time and our place in the world, opening the door to modern geoscience. Image by PawelS, CC BY-SA 4.0 <https://creativecommons.org/licenses/by-sa/4.0>, via Wikimedia Commons. https://commons.wikimedia.org/wiki/File:Hutton%27s_unconformity_at_Siccar_Point,_Scotland.jpg

PROFESSIONAL GEOSCIENTISTS

Their Importance in Public Protection & The Future of Geoscience

Introduction

Modern professional geoscience is a collage of biology, chemistry, physics, mathematics, and soil science repurposed with modern tools to understand and explain the world around us. The work has allowed the public to find critical resources to fulfill its ambitions, navigate the world with better awareness of our myriad impacts on the earth, all the while providing endless fascinations about the meaning of deep time. Professional Geoscientists (P.Geo.s) are found in myriad roles in today's society.

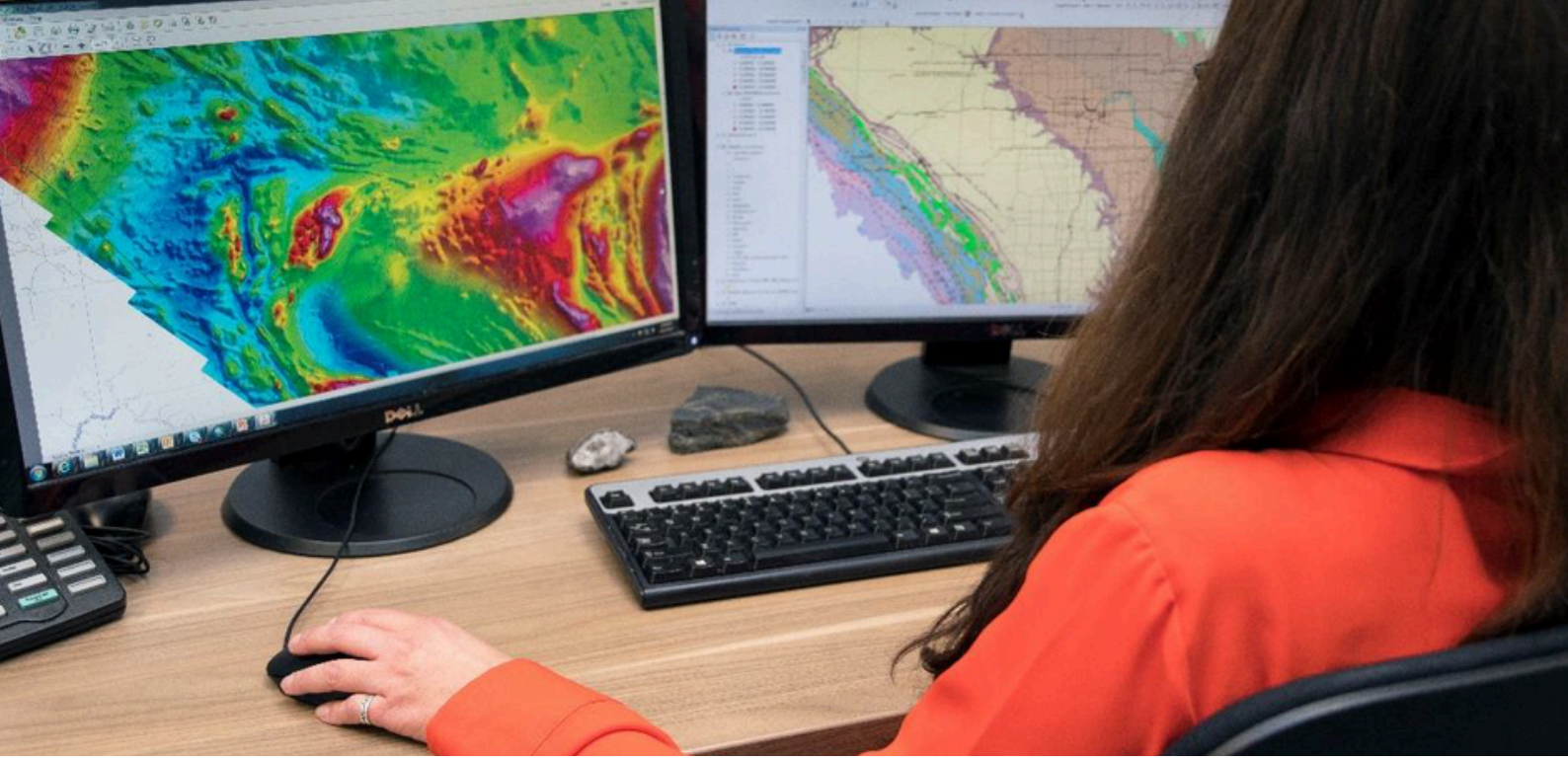


Let's talk Professional Geoscience

As we stand on the brink of new technological and environmental challenges, the importance of geoscience and professionalism within this field cannot be overstated. This article explores why the work of the registered Professional Geoscientist is important, the significance of professionalism in this field, and the inspiring future that lies ahead for the public because of this vital discipline. Activities of Professional Geoscientists are examined here in a few areas of geoscience: resources, geomorphology, geophysics, and environment.

Resources

Canada has a deep relationship with mineral resources. Nationally, the resources sector is a key part of the country's gross domestic product. Internationally, Canada is known to be on the forefront of mining finance and operations throughout the world. For these reasons, the public has a high stake in those that are operating in this sector. Resource sector geoscientist Mary-Anne Hildebrandt explains that economic geologists "...have a fundamental role in identifying, assessing, and managing resources in the extractive industry, which are integral to the function of the global economy and the raw materials used for the manufacture of all technology."



Mapping critical resources using the latest technology. Photo courtesy of Geoscientists Canada

Mary-Anne explains the importance of professionals to critical mineral exploration: “Professional Geoscientists conduct comprehensive evaluations of mineral deposits, ensuring that resource estimates reflect true values within accepted tolerances. This meticulous work safeguards the interests of the investing public and affected communities.”

As an experienced professional Mary-Anne observes that “as global demand for minerals rise—especially for battery metals considered critical to the energy transition—the role of economic geologists will be increasingly vital. Mineral resources, while abundant in Canada, are non-renewable.” Mary-Anne identifies the key role that geoscientists have in finding ways to meet public needs - she says “Despite the growing demand, in-situ mineral resources that are economical to extract are becoming increasingly more difficult to locate near Earth’s surface, and the ore bodies are becoming more complex at depth. Economic geologists are already being called upon to identify new sources of minerals ranging from closed mines or mine tailings facilities, and perhaps, eventually from closed areas of landfills.”

It's been said that geoscientists in the resource sector are the first responders of the transition economy, and without these first responders we have little chance of reaching our public aspirations. Professional Geoscientists in this sector are using geophysics, engineering, geographical information systems (GIS) and cutting-edge tools like machine learning and complex models to enhance our understanding and development of mineral and geo-energy resources, buying vital time to move toward key public objectives. More and more, the same expertise is switching from carbon extraction to carbon capture and storage (CCS) and geothermal energy storage, while watching out to minimize risks to vital water supplies and the people that live in vulnerable areas.

Hazard Risks

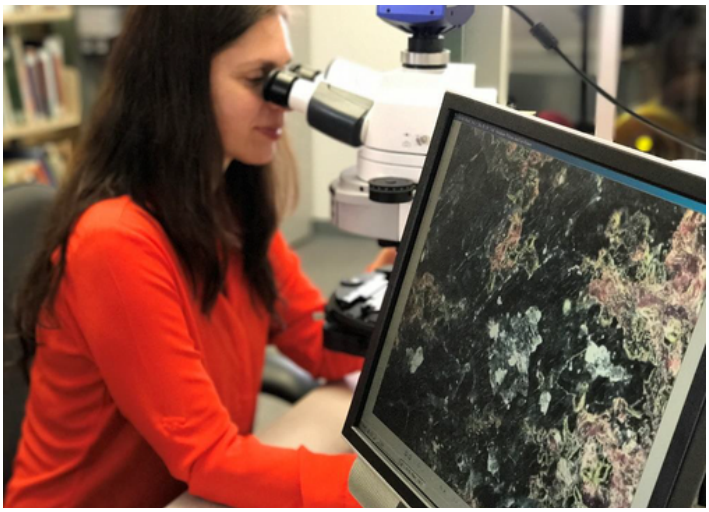
The world is rapidly urbanizing and expanding with populations inhabiting areas that previously had sparse infrastructure – this has led to new concerns with flooding, erosion, unstable slopes, unsustainable groundwater extraction, pollution threats to water supplies. In a bigger picture, concerns of changes to climate have heightened the volume and voracity of the conversation.

Geomorphologist Imran Khan points out that Professional Geoscientists work on a wide swath of situations spatially and temporally; he says, “Geomorphic systems respond to disturbances on vastly different timescales, ranging from geological epochs to brief periods or isolated events, sometimes with profound effects.” He cautions “We still face significant knowledge gaps in understanding how human alterations influence these systems, which can subsequently impact public safety. We must continually advance our scientific understanding of applied geomorphology through research and development. "

Imran sees geomorphologists having an important role by “managing environmental impacts of developments, through mitigation and restoration strategies that protect and improve the environmental health that directly and indirectly benefits public health and safety.” He emphasizes the role of professionals in this space in mitigation planning for flooding, erosion, unstable soils and bedrock, shoreline/watercourse instability and wetland alterations. Imran asserts that “assessing and communicating the risks associated with natural geological processes and hazards is essential for safeguarding the public and environment. This includes defining erosion hazards for development setbacks and assessing risks linked to infrastructure projects.” Imran demonstrates the central role of professional geoscience in public protection.

In Eastern Ontario hydrogeologists inform upon a regional hazard risk through the assessment of water and earthquake induced landslides of sensitive clays. These Professional Geoscientists are mapping areas of elevated safety risk, allowing policymakers to reduce risks to public safety and risk from damage or destruction of property such as happened at the Lemieux landslide in 1993. When policymakers discuss Natural Assets, professionals are naturally called upon to provide advice on the potential effects of these assets.

Lemieux Landslide, Eastern Ontario. Geologic Survey of Canada Miscellaneous Report 56. The Lemieux landslide of June 20, 1993, South Nation Valley, southeastern Ontario - a photographic record. Photo by S.G. Evans. Image is a copy of an official work published by the Government of Canada. The reproduction has not been produced in affiliation with, or with the endorsement of the Government of Canada. https://www.nation.on.ca/sites/default/files/1993%20Photographic%20Record_Lemieux%20Landslide_G.R%20Brooks%2C%20et%20al_Natural%20Resources%20Canada.pdf



Examining soil and rock properties to support engineering. Photo courtesy of Geoscientists Canada

The Blue Marble photograph (NASA)

Milan Situm, a geophysicist, explains the role of geophysics in public hazard management through providing:

(1) insight to the bigger structural and stratigraphic picture, and (2) direct (in-situ) measurements of soil and rock properties, such as strength, required by design engineers and geotechnical engineers.

Milan states "These data are otherwise only available through approximation not direct measurement. This superior information supports public protection when deciding where and how to safely build structures." Milan also points out that civil engineering investigations of existing infrastructure have also relied in part on geophysical engineering because bridges, dams, tunnels and other civil works can be scanned for structural weaknesses and as-built design flaws non-intrusively. Accordingly, he states "The public is protected by identifying problems which can be corrected before the structures become safety hazards or fail entirely."

The geoscience work in risk characterization and mitigation connects to many disciplines and situations on multiple scales over time and area, for direct and indirect public

Environment

Environmental geoscience is perhaps the latest of the main geoscience players. The iconic "blue marble" photograph of Earth from space in the 1970s sparked an environmental awareness of the fragility of our planet that evolved into a movement and eventually an industry.

These days environmental geoscientists are at the forefront of this growing industry of intense public interest. These Professional Geoscientists conduct essential functions such as assessing soils for contaminants, evaluating risks to various human and ecological receptors and preventing or minimizing exposure. Alicia Kimberley, a hydrogeologist, highlights geoenvironmental activities involving: "Legacy contaminants, maintaining groundwater recharge, mitigating flood concerns" and identifying and cleaning up "emerging contaminants" as public concerns that environmental geoscience tackles.

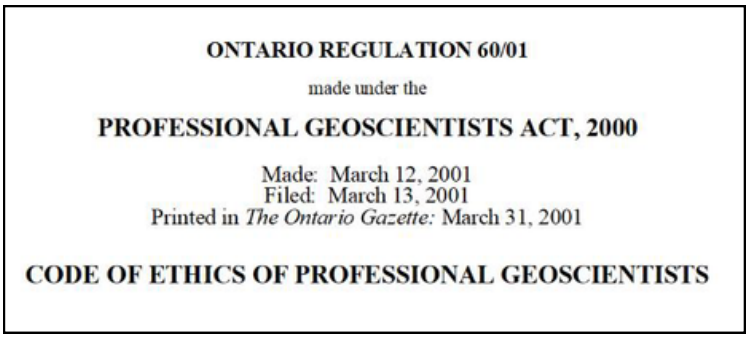
Environmental Professional Geoscientists conduct site assessments, manage removal of contamination source(s) (such as the leaking underground storage tank shown here) and manage soil and groundwater remediation to reduce hazard risks to the public. Photo courtesy of Hubley Geosciences Limited

However, Alicia warns that "consistency between professional practitioners and regulatory bodies is essential to manage these challenges effectively." Alicia also points out the growing need for qualified geoenvironmental professionals: "With the fast-paced growth of this field, finding the next generation of geoscientists is critical. The collaboration between practitioners and regulators will be essential to keep up with industry and scientific advancements."

Geoenvironmental professionals' work reflects society's moral values through a systematic and evidence-based approach to public protection, adhering to various strict Acts, Regulations, and best practices developed over the past few decades. These professionals are instrumental as subject matter experts for policymakers and the legal system as society's administrative and judicial systems evolve with public protection at the core.

Professional Geoscientists have also been busy assessing groundwater chemistry in detail throughout Ontario and elsewhere. This geochemistry profiling identifies issues of public health and allows decision-makers to make informed risk-based decisions regarding permitting, water use, and aquifer source protection. The work facilitates public planning and policy development to reduce municipal costs. The work is often conducted at a watershed scale, bringing multiple municipalities together to solve common water supply and sustainability issues and reduce risks of contamination of public water supplies by coordinating efforts across the entire watershed.

These example activities highlight the support of Professional Geoscientists for some fundamental public interests. Whether in the economic / resource sector, geomorphologists or geophysicists involved with hazard risks or geochemists or hydrogeologists involved with environmental geoscience, they excel at the roles needed by the ever-evolving expectations of the public.



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CODE OF ETHICS OF PROFESSIONAL GEOSCIENTISTS

Photo from Professional Geoscientists Ontario (PGO.ca)

Why is Professionalism in Geoscience Important?

Professionalism represents an effective process to keep up with evolving public needs and expectations.

Scientific knowledge in the modern western sense was, until recently, the purview of a select few individuals in privileged societies that was inaccessible to the majority of citizens. These privileged individuals were entrusted with a monopoly of knowledge from positions in learned societies that advised the public on issues of importance.

Through time, awareness and societal evolution, the monopoly of western knowledge has evolved to become more approachable for a more diverse array of learned citizens, trained in the various specializations. Along with the privilege of specialized knowledge comes a continued expectation to uphold ethical principles and to prioritize public protection above all else and otherwise balance remaining needs.

In Canada, Professional Geoscientists are regulated, with various public expectations entrenched in provincial and territorial legislation (Acts) and defined in the Regulations and By-Laws. Professional Geoscientists are licensed (just as are engineers, doctors, lawyers, etc.). These individuals are expected to adhere to the Code of Ethics of their jurisdiction, a principle-based commitment to protect the public above all other priorities. Otherwise, they are subject to consequences including discipline and/or removal of the privilege of licensure. The key principles are to maintain integrity, respect and fairness, identify and report risks to others, and understand and adhere to one's own limitations. Professionals are expected to regularly participate in continuous professional development, now usually mandatory for Professional Geoscientists[1], to keep their knowledge current in this ever-changing field.

The Future of Geoscience

"Geologic seeing is poetic vision constrained by the sobriety of science, a series of imaginative leaps disciplined by examination and measurement.."
– Frodeman, 2003

Mary-Anne Hildebrandt is fully aware of the Professional Geoscientists' obligation when conducting their work: "Upholding ethical principles throughout [geoscientists'] work is not merely essential; it is imperative for economic geologists because they serve as stewards of natural resources." Mary-Anne points to the professionals' obligations when she states: "Continuing professional development, leveraging technological advancements, and aligning with the evolving regulatory framework are also means by which economic geologists ensure they are competent in their practice." Indeed, Mary-Anne's sentiments apply to Professional Geoscientists in all disciplines.

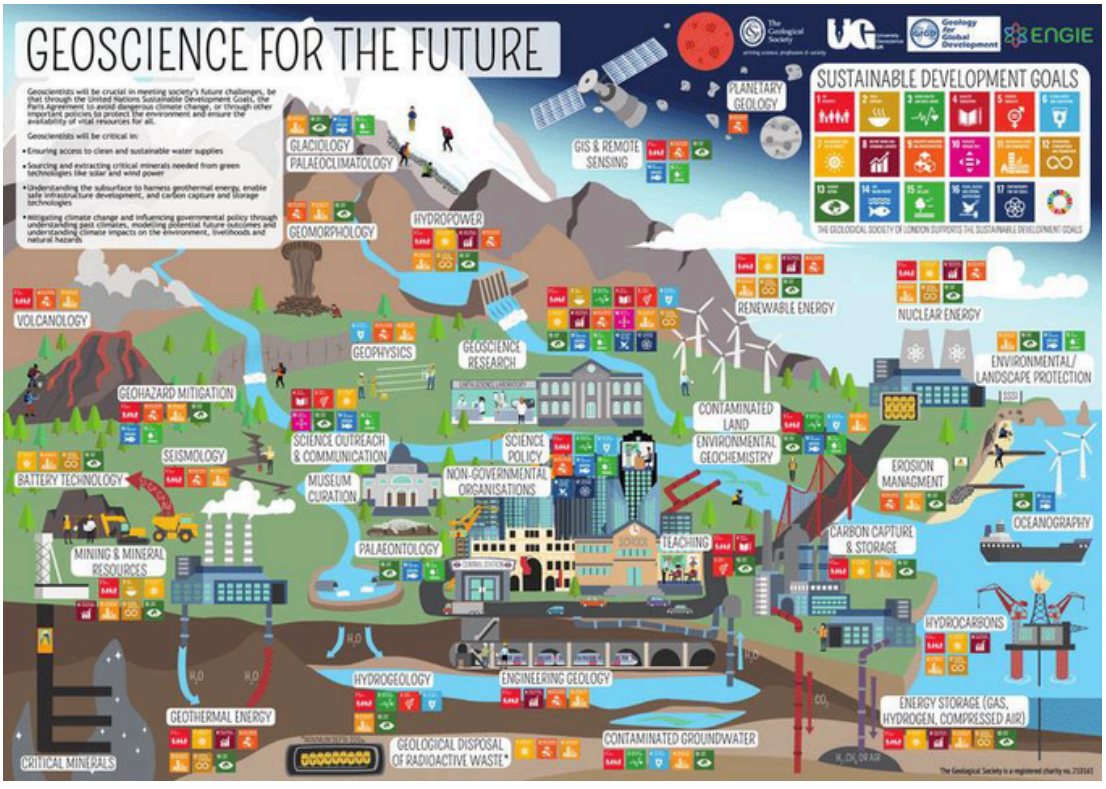
These professional roles and responsibilities have been developed to uphold the highest principles in order to maintain the privilege entrusted to these professionals by the public. These principles are entrenched in the provincial and territorial Acts and Regulations creating a landscape of self-regulatory organizations throughout the country2. As a result, professionals maintain high expectations of peers and are personally and professionally invested in the public interest. In this way the needs of the public are maintained while public aspirations are made possible.

Through the establishment and evolution of rules and expectations of Professional Geoscientists in Canada the bar is set high, and it's a system widely known to be one of the most robust and admired systems of regulation in the world!

The future of geoscience is both challenging and inspiring. Provincial, territorial and national aspirations are commonly reflected in critical mineral strategies, climate risk planning and sustainable resource (non-renewable, renewable, groundwater, etc.) management plans. As global demand for minerals rises, especially for critical battery metals, the role of Professional Geoscientists will become increasingly vital.

Professional Geoscientists are relied upon to identify new sources of minerals, manage environmental impacts, and innovate sustainable practices – indeed, to exercise geologic seeing.

Despite the present and future need, interest in geoscience is waning, evidenced by shrinking university enrollments at the B.Sc. level. University program directors are under pressure across the country and the world to shrink core offerings, combine with other fields or shutter the program doors altogether, all of which have happened in Ontario in recent years. This is one of the great paradoxes of our time, as the need for geoscience has never been greater. As Alicia Kimberley identified, the demand for new geoscientists is outpacing the supply.



Geoscience P.Geo. jobs and relationship to UN Sustainable Development Goals. Poster created by The Geological Society of London. © The Geological Society, 2021. This work is licensed under CC BY-NC-ND 4.0. Original can be found here: https://www.geolsoc.org.uk/Posters?fbclid=IwY2xjawHNzXpleHRuA2FlbQIxMAABHQ4wEbJy30X1J9FDXugW8vi1LeQLDSNoHDOmPo4i4cqVdQs303cuMWorNA_aem_olINNhpNayvlUb5fg33WiA

It has become clear in the past few years that a sustainable future for geoscience will require a mobilization of awareness through effective communication about what geoscience is, what geoscientists do, and why it is vital to the lives of the many diverse groups that constitute the public that geoscientists protect.

Some work to rekindle an interest in geoscience is underway. There are numerous initiatives slowly working on this. On Canada's west coast, adoption of the United Nations Declaration for the Rights of Indigenous Peoples (UNDRIP) into B.C. law has prompted a new level of thought leadership in how resources are managed. On the east coast, the New Brunswick Grade 11 high school environmental geoscience curriculum (environmental-geoscience-110.pdf) has been recently updated to include the concept of Etuaptmumk, the Mi'kmaw word for Two-Eyed Seeing (Guiding Principles (Two Eyed Seeing) | Integrative Science).This concept encourages consideration of parallel but distinct western knowledge systems and Indigenous ways of knowing when viewing an issue. In Central Canada (Fleming College, Ontario), a post-secondary program spearheaded by Joanna Hodge has created an accessible field camp to remove barriers to diverse participation. Also, braiding the entire nation, a growing surge of interest is growing for the advent of geoparks and indigenous protected and conserved lands (and water), where biodiversity and geodiversity merge with the public consciousness and lands are more sustainably managed by local experts, supported by geoscientists and others.

Stylized Mount Logan above the clouds, in brilliant light. Mount Logan is Canada's highest peak, named after geologist and first Director of the Geological Survey of Canada Sir W. Logan. The mountain peaks have been of intense cultural significance to Indigenous peoples for thousands of years - Drawing by Isaac Hubley

This forward-looking seeing of geoscience programs and curricula will contribute to Canada's reconciliation efforts and support the fulfillment of Canadian society's aspirations in sustainable development and inclusion.

Internationally, organizations are trending toward geoscience as the focal point to advance the United Nations Sustainable Development Goals (UN SDGs), particularly with natural resources such as water, critical minerals and non-renewable energy sources (Geology for Global Development, The Groundwater Project, CRIRSCO, etc.).

Closing Remarks

Geoscience is a fundamental tenet of public protection. Support of the geoscience profession can ensure that Professional Geoscientists can effectively and sustainably help safeguard the future desired by the public. As we face new environmental and technological challenges and reach toward the collective aspirations of the nation and the world, their role will become even more critical. Professional geoscience not only compliments our society's evolving values but is poised to inspire a new generation to continue the legacy of protecting and reaching a new understanding with the planet and each other.

Geoscience is not just a profession; it is a commitment to the greater good of a wider range of society than ever before. Adequately fostered and resourced, professional geoscience will reach brilliant new heights.

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The Groundwater Project The Groundwater Project

About

This article was prepared by a committee of volunteers from Professional Geoscientists Ontario (PGO) working to plan a celebration of the 25th anniversary of the Professional Geoscientists Act on June 6, 2025, in Toronto. The thoughts and opinions expressed are those of the dedicated PGO volunteers and authors who gave their time and professional input to this endeavor, not of the PGO. The committee would like to extend thanks to the following authors.

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Contributing authors:
Mary-Anne Hildebrandt, BSc, BAH, MEERL, P.Geo., FGC, has worked in the mining and exploration industry for 18 years, with experience in all aspects of economic geology. She was nominated for the Women in Mining Canada 2020 Trailblazer Award and the De Beers safety leadership award (twice). She was designated a Fellow of Geoscience Canada (FGC) in 2022. She has had the unique experience of working as a geoscientist on an operation from “cradle to grave” and progressed her career during that time to a Competent Person (CP). Mary-Anne holds a BSc in Geological and Earth Sciences, a BA in Political Studies, and a Master of Earth and Energy Resource Leadership degree. In 2022, she was elected as Vice President of the Professional Geoscientists Ontario (PGO) Council and assumed the role of President in June 2023 for a one-year term. Mary-Anne is presently the Immediate Past President on PGO’s Council. Dedicated to developing and defining geoscience best practice, Mary-Anne is a leader and mentor

Imran Khan, M.Sc., P.Geo. Imran Khan is an active member of the Professional Geoscientists of Ontario, Chair of the Geomorphology Sub-committee, and holds a restoration certification through the Society for Ecological Restoration. His 23-year career spans vital aspects of geomorphology, including natural hazards, erosion processes, and channel and valley corridor rehabilitation. His strategic advice in hazard risk management, protection, mitigation, and implementation benefits both private and public sectors, contributing to safer and more resilient environments. He advocates for collaboration and knowledge sharing in applied geomorphology, emphasizing that interdisciplinary approaches can foster innovative solutions and significant advancements.

Milan Situm, P.Geo., FGC. Mr. Situm has been employed in the niche market of geophysical applications for Civil, Structural, Geotechnical and Geological Engineering as well as applications to Hydrogeology and Environmental Assessments for 35 years. He has his B.Sc. degree in Applied Earth Science (Geophysics) from the University of Waterloo. He is a licensed member of the PGO and is involved as a member of other organizations including the EEGS, KEGS, PDAC, CGS, the Canadian Dam Association and Canadian Tunnelling Association. Mr. Situm is currently the Vice President of Engineering applications for Simcoe Geoscience Ltd. responsible for all applications to new and existing civil infrastructure.

Alicia Kimberley, M.Sc., P.Geo. Alicia is a geoscientist, specifically practicing in the fields of hydrogeology and geoenvironmental sciences with over 13 years of industry experience. Alicia’s hydrogeological/geoenvironmental experience includes local and regional scale groundwater assessments, design and execution of aquifer tests for water supply, excess soil planning support, and Phase One and Two Environmental Site Assessments. Alicia currently sits on the Professional Geoscientists Ontario (PGO) council as an elected Councilor-at-Large and is the chair of PGOs Professional Practice Committee and similarly sits on Geoscience Canada’s Professional Practice Committee.