



# **APPENDIX K**

## **CURRICULA VITAE**



**Education**

*M.Sc. Hydrogeology,  
University of Waterloo,  
Waterloo, Ontario, 1997*

*B.Sc. Earth Sciences,  
Honours, Memorial  
University of  
Newfoundland,  
Newfoundland, 1995*

**Mississauga**

***Phyllis McCrindle, B.Sc., M.Sc., P.Geo. – Senior Hydrogeologist,  
Associate***

Phyllis is extensively involved with on-going hydrogeological investigations for the aggregate, mining, power, waste management and oil and gas industries.

She is a Project Manager responsible for developing and implementing physical and chemical hydrogeologic studies. Responsibilities include preparation of proposals/work plans, tender documents, liaising with clients and regulating agencies, coordination of multi-disciplinary field investigations and/or drilling and monitoring programs. These investigations typically include resource evaluation; an assessment and interpretation of groundwater impacts created by extraction and/or dewatering activities by mines, quarries, golf courses and other similar facilities; preparing Permit to Take Water applications; conducting hydrogeological assessments for rezoning of lands and licence applications under the Aggregate Resources Act; assessment of hydrochemical trends and compliance with regulatory policies and guidelines; interpretation of isotopic analysis of groundwater samples to determine origin and age of water to assess groundwater recharge and discharge; interpretation of isotopic and geochemical results from mine tailings, groundwater and surface water to determine biodegradation for assessment of surface water quality impacts such as acid mine drainage.

Phyllis is familiar with, and frequently uses, a wide range of federal, provincial and municipal compliance and regulatory policies and guidelines.

**Employment History**

***Golder Associates Ltd. – Mississauga, Ontario***

*Senior Hydrogeologist, Associate (1998 to Present)*

Responsible for: physical and water quality evaluations of proposed and existing mines, landfills and civil construction projects including assessment of resource quality and quantity; hydrochemical trends and compliance with regulatory policies and guidelines; interpretation of isotopic analysis of groundwater samples to determine origin and age of water to assess groundwater recharge and discharge; interpretation of geochemical results from mine tailings, groundwater, and surface water to determine biodegradation for assessment of surface water quality impacts such as acid mine drainage; and interpretation of groundwater impacts created by groundwater extraction activities by quarries, golf courses, etc.

***University of Waterloo – Waterloo, Ontario***

*Graduate Student and Research Assistant (1995 to 1997)*

Laboratory research in hydrochemistry for the refining of techniques used to analyze oxygen and nitrogen isotopes from nitrate.



***Newfoundland & Labrador Department of Natural Resources – St. John's, Newfoundland***

*Senior Field Assistant (1995 to 1995)*

Assisted with the assessment of Quaternary geology research in western Newfoundland including coastal and inland areas.

***Memorial University of Newfoundland – St. John's, Newfoundland***

*Research Assistant (1994 to 1994)*

Assisted with the collection and geochemical analysis of water samples.

***Newfoundland & Labrador Department of Mines and Energy – St. John's, Newfoundland***

*Junior Field Assistant (1993 to 1993)*

*Junior Field Assistant (1993 to 1993)*

Assisted with field and laboratory work for geological assessment of inland and coastal regions in southeastern Labrador.



## PROJECT EXPERIENCE – HYDROGEOLOGY

**Iron Ore Company of  
Canada (IOC)**  
Wabush, Labrador,  
Canada

Iron Ore Company of Canada (IOC) owns and operates a series of open pit iron ore mines near Labrador City, Labrador. Wabush 3 and Wabush 6 sites required additional study to raise the level of understanding of the developments to Order of Magnitude Study (OMS) level. As a part of this OMS, several technical studies were required including a hydrogeological and hydrological study of the planned open pit developments for the Wabush 3 and Wabush 6 iron ore bodies. The main objectives of this study were to characterize the hydrogeological and hydrological conditions of the proposed mines and the surrounding area; determine the current groundwater levels within the areas of the two proposed pits; provide a preliminary indication of aquifer horizons and transmissivities; determine a preliminary dewatering strategy; and specify the work program required for the Pre-feasibility Study.

**Weeks Pit and Quarry**  
Parry Sound, Ontario,  
Canada

This aggregate resource inventory included field investigation and laboratory analysis, interpretation of background information, test pit and borehole drilling, sieve analyses, development of cross-sections, delineation of overburden and bedrock deposits, deposit quality and calculation of reserve tonnages.

**Cerro Matoso**  
Bogota, Columbia

Assessment of hydrogeological and hydrological baseline data for proposed mine expansion.

**Xstrata Copper**  
Peru

Hydrogeologist responsible for analysing groundwater and surface water flow and quality data collected as a part of baseline studies for a proposed copper mine in Peru. This data collection and analysis is ongoing and will be presented in an Environmental Assessment report that will examine the baseline hydrogeologic conditions, provide a water management strategy, assess the potential impacts during construction and operation and suggest mitigation required upon closure of the mine.

**Canada Gypsum  
Company**  
Hagersville, Ontario,  
Canada

Conducted a diamond drilling investigation and core logging of bedrock for Canada Gypsum Company.

**Xstrata Nickel**  
Brazil

Hydrogeologist responsible for developing and coordinating a work plan that included a drilling and monitoring program to establish the baseline against which the potential impact of a proposed mine on groundwater and locally significant environmental features can be assessed. This field study required coordination of drilling, monitoring well installation, hydraulic conductivity testing, groundwater level monitoring and groundwater quality testing. This project also requires coordinating Golder staff internationally to conduct field work and data analysis, and ongoing liaison with the client and international regulating agencies. This data collection and analysis is ongoing and will be presented in an Environmental Assessment report that will examine the baseline hydrogeological conditions to provide a water management strategy, assess the potential impacts during construction and operation also suggest mitigation required upon closure of the mine.



**Adams Mine**  
Kirkland Lake, Ontario,  
Canada

Conducted a diamond drilling investigation through banded iron formation for a hydrogeological investigation. The boreholes were drilled at 45 and 50 degree angles from horizontal and extended over 300 m to reach the bedrock underneath the open pit mine. The rock core was logged which involved describing the geology and fractures and determining rock quality indices. On completion of drilling, packer testing was carried out to determine hydraulic conductivity of the bedrock.

**R.W. Tomlinson**  
Ontario, Canada

Hydrogeologist for field studies completed for Tomlinson in support of an application for a quarry below water. The hydrogeological study included drilling, monitoring well installation, hydraulic conductivity testing, groundwater level monitoring, groundwater quality testing and the assessment of potential impacts on the surrounding water wells and natural environment features, such as, wetlands and watercourses.

**Nelson Aggregate Co.**  
Burlington, Ontario,  
Canada

Hydrogeologist responsible for coordinating and carrying out a drilling and monitoring program to establish the potential impact of a proposed Quarry expansion plan on groundwater and locally significant environmental features. This field study required coordination of multi-disciplinary environmental investigations, drilling, monitoring well installation, hydraulic conductivity testing, groundwater level monitoring and groundwater quality testing. The study also included an evaluation of the bedrock resources on site and confirmation of quality to support high quality end products for the client. This data was analyzed and presented in a hydrogeologic report prepared in support of a licence expansion application under the Aggregate Resources Act.

**Lafarge Canada Inc.,  
Canada Brick/Hanson  
Brick Ltd., Brampton  
Brick Ltd.**  
Ontario, Canada

Project Manager for ongoing monitoring of over 15 sites across Ontario for groundwater level data, groundwater and surface water quality, quarry pumping volumes and conducting an assessment of potential groundwater impacts from various quarries and pits in Ontario, as part of the conditions of the Permit to Take Water, including preparation of annual monitoring reports submitted to the Ministry of the Environment.

**Lafarge Canada Inc.,  
Canada Brick/Hanson  
Brick Ltd., Brampton  
Brick**  
Ontario, Canada

Project Manager and Senior Hydrogeologist for several licence applications of below-water quarries in Ontario. These programs require the development and implementation of drilling, monitoring well installation, hydraulic conductivity testing, groundwater level monitoring and groundwater quality testing. This data was analysed and presented in a hydrogeologic report prepared in support of a licence application under the Aggregate Resources Act.

**SkyPower Wind Parks -  
SkyPower Corp.**  
Various, Ontario,  
Canada

Project geologist/hydrogeologist responsible for the characterization of the geophysical environment and conducting the effects assessment of seven wind park projects for SkyPower Corp. in Ontario. All projects will be assessed under a harmonized Ontario Environmental Assessment Act (OEAA) and Canadian Environmental Assessment Act (CEAA) review process.

**Adelaide Wind Farm -  
Air Energy TCI**  
Adelaide Metcalfe,  
Ontario, Canada

Project geologist/hydrogeologist responsible for the characterization of the geophysical environment and conducting the effects assessment of the Adelaide Wind Farm project for Air Energy TC. The project will be assessed under the harmonized OEAA and CEAA review process.



- Romney Wind Power Project**  
Essex County, Ontario, Canada  
Conducted senior review of the existing geophysical environment and the effects assessment of the project on the geophysical environment for the Romney Wind Power Project.
- St. Clair Power, L.P.**  
St. Clair Township, Ontario, Canada  
Project geologist/hydrogeologist responsible for the characterization of the geophysical environment and conducting the effects assessment of the proposed 570 MW combined cycle, natural gas-fired electricity generating station.
- Golf and Country Club**  
Caledon, Ontario, Canada  
Hydrogeological assessment of groundwater recharge and discharge for the proposed expansion of a golf course.
- Golf and Country Club**  
Markham, Ontario, Canada  
Hydrogeological assessment of groundwater levels and pumping rates in order to determine the effects of local pumping and irrigation on near by well fields.
- Royal Bank**  
Toronto, Ontario, Canada  
Compilation of pertinent hydrogeological and geological data in order to assess the potential to develop an emergency groundwater supply in Toronto in the event there is a disruption to the municipal water supply.
- Bruce A Refurbishment for Life Extension and Continued Operations Project**  
Tiverton, Ontario, Canada  
Prepared the Geology, Hydrogeology and Seismicity Environment Technical Support Document (TSD). The TSD was prepared as part of the Environmental Assessment Technical Studies for project. Potential effects from project works and activities for both refurbishment of all four reactors and operational phases (restart) of units 1 and 2 were quantified for their potential to effect soil quality, groundwater quality, groundwater recharge and flow. Where necessary, mitigation measures for the predicted effects were recommended.
- Bruce A Units 3&4 Restart Project**  
Tiverton, Ontario, Canada  
Project managed the Geology, Hydrogeology and Seismicity component for the Bruce A Units 3&4 Restart Environmental Assessment. Prepared a technical supporting document that outlined the Bruce A Geology, Hydrogeology, Hydrogeochemistry and Seismicity.
- Darlington NGS Used Fuel Dry Storage**  
Darlington, Ontario, Canada  
Prepared the Geology, Hydrogeology and Seismicity Environment Technical Support Document (TSD). The TSD was prepared as part of the Environmental Assessment Technical Studies for the Darlington Used Fuel Dry Storage project. This involved assessment of the project works and activities of the construction and normal operation phases of the project that have the potential to interact with the environment to predict possible changes to the environment due to the project. If necessary, mitigation measures for the predicted effects were recommended.
- Pickering NGS Waste Management Facility II**  
Pickering, Ontario, Canada  
Project managed the Geology, Hydrogeology and Seismicity components of the Environmental Assessment Technical Studies for the Pickering Waste Management Facility Phase II (PWMF II) project. Work included assessment of the project works and activities of the construction, normal operation and maintenance phases of the PWMF II project that have the potential to interact with the environment to predict changes to the environment.



**Pickering A Return to Service Environmental Assessment**

Pickering, Ontario, Canada

Assisted project management of the Geology, Hydrogeology and Seismic component for the Pickering A Return to Service Environmental Assessment. Prepared a technical supporting document that outlined the Pickering A Geology, Hydrogeology, Hydrogeochemistry and Seismicity.

**Edgewood Landfill**

New City of Hamilton, Ontario, Canada

Hydrogeologist responsible for developing and conducting a field program which included a soil/waste sampling program to delineate the types of waste in the landfill, augmenting the existing on site monitoring wells by drilling and installing additional monitoring wells across the landfill, installing shallow well points around the perimeter of the site, installing shallow gas probes along the margin of the landfill, conducting water sampling at the new and existing surface water and groundwater/leachate monitoring sites. These field investigations were used to define the landfill cover and lining, the types of waste materials in the landfill, volume of waste, hydrogeological conditions within and around the landfill, leachate quality, groundwater and surface water quality within the landfill footprint and also potential off site impacts. A preliminary ecological risk assessment was conducted as well.

**Brow Landfill**

Flamborough, Ontario, Canada

Project Hydrogeologist for the Redland Quarries (now Lafarge) industrial waste landfill on the Niagara Escarpment, which no longer accepts waste and is being rehabilitated. Regulations required that continued monitoring of groundwater levels and sampling of surface and groundwater be carried out at the site in order to maintain compliance. Annual reports are submitted to the Ministry of the Environment summarizing the results and interpreting the required steps for future monitoring.

**Enbridge Pipelines Inc.**

Flamborough, Ontario, Canada

Hydrogeological and geochemical assessment of a multiple release petroleum hydrocarbon contaminated site. The study included a large groundwater quality monitoring program to assess the extent and remediation potential in an environmentally sensitive area. The project included: the creation of a database of all existing soil and groundwater data including an analysis of the existing data; identification of data gaps and recommendation for further investigation; expanded the existing borehole network and developed a groundwater quality monitoring program with the aim of assessing the natural attenuation potential of the site and liaison with the client and the MOE to ensure the needs of all parties were met.

**PROJECT EXPERIENCE – HYDROCHEMICAL**

**Brow Landfill**

Flamborough, Ontario, Canada

Ongoing monitoring of groundwater and surface water quality, including detailed assessments of hydrochemical trends, landfill related impacts on water quality and compliance with regulatory guidelines and policies.

**Falconbridge**

Falconbridge, Ontario, Canada

Hydrochemical assessment of mine tailings and sludge in order to provide treatment options upon closure.





**Commander Facility**  
St. Jean, Quebec,  
Canada

Characterization and the evaluation of subsurface conditions at an industrial plant site. Specifically an assessment of the impact of volatiles and cyanide on groundwater, soil and soil vapour.

**Redland Quarries (now Lafarge)**  
Flamborough, Ontario,  
Canada

Ongoing monitoring of groundwater levels, groundwater and surface water quality and quarry pumping volumes, at the Redland Quarry Operations in Flamborough, Ontario, as part of the conditions of the Permit to Take Water, including preparation of annual monitoring reports submitted to the Ministry of the Environment.

**Phase IV**  
Smithville, Ontario,  
Canada

Implementation of the collection of groundwater samples for analysis of inorganics, volatile organics, semi- volatile organics, PCBs, TCB and metals from the groundwater underlying Ontario's largest PCB storage site. Delineation of the lateral and vertical distribution of various geochemical parameters, specifically PCB and VOCs. Attending public information sessions aimed at keeping the public abreast of the developments and options available to contain and remediate the PCB site.

**Pickering Nuclear Generation Station (NGS), Groundwater Loadings Database**  
Pickering, Ontario,  
Canada

Project managed the preparation of a groundwater loadings database for the Pickering Nuclear Generation Station.

**Pickering A Return to Service Follow-Up Monitoring**  
Pickering, Ontario,  
Canada

Carried out analysis of groundwater quality sampling as part of the Water Quality Follow-Up Monitoring Program to define baseline and post-restart conditions.

**Bruce A Return to Service Follow-Up Monitoring**  
Tiverton, Ontario,  
Canada

Carried out analysis of groundwater quality sampling as part of the Water Quality Follow-Up Monitoring Program to define baseline and post-restart conditions in Lake Huron to confirm the EA Study conclusions

**Minera Yanacocha**  
Lima, Peru

Using Aqtesolv to analyse constant head and slug test data in order to determine transmissivity (T), storativity (S) and hydraulic conductivity (K).

**City of Burlington**  
Burlington, Ontario,  
Canada

Pump test in bedrock conducted in Kern Cliff Park using transducers to record recovery. Down loading of the transducer data and analysing the data in a numerical model (Aqtesolv) to determine the hydraulic properties of the bedrock.

**Canada Brick**  
Mississauga, Ontario,  
Canada

Specialist for assessment of geological controls upon shale quality at the Canada Brick Britannia Road quarry site. The work was carried out in conjunction with quality control estimate of shale reservoir on the property.

**Dufferin Aggregates**  
Ontario, Canada

Project Director for numerous aggregate projects at quarries and sand and gravel pits within Ontario including resource evaluations, hydrogeological investigations and environmental assessments.





**Glanbrook Landfill**  
New City of Hamilton,  
Ontario, Canada

Constructing a data management system for the active Glanbrook Landfill as a pilot project for eleven other closed landfill sites in the City. This project also involved the compilation of the Annual Report for the Glanbrook site.

## **PROFESSIONAL AFFILIATIONS**

Ontario Groundwater Association

National Groundwater Association

Association of Professional Geoscientists of Ontario

Ontario Stone, Sand and Gravel Association (Environment Committee)

Association of Professional Geoscientists of Nova Scotia



**Education**

*M.Sc. Hydrogeology,  
University of Waterloo,  
1981*

*B.Sc. Geology (Hons),  
University of Western  
Ontario, 1975*

**Golder Associates Ltd. – Mississauga**

***Robert D. Blair***

Rob Blair is a senior hydrogeologist, engineering geologist and Principal with 30 years of experience in the Golder Associates office in Mississauga, Ontario. He provides a strong geological and hydrogeological background to the assessment of various engineering and groundwater related projects ranging from civil engineering project associated with tunnels, excavations, dams, roads to environmental assessments associated with mining and quarry developments, power projects or waste management including provision of expert testimony. He has been involved with federal and provincial environmental assessments for the waste, power and mining industries. His project involvement also provides regional and local understanding to groundwater flow and control as well as groundwater quality including interaction with surface water.

**Employment History**

***Golder Associates Ltd. – Mississauga, Ontario***

*Principal, Senior Engineering Geologist and Hydrogeologist (1979 to Present)*

Responsible for management of engineering geological, hydrogeological and environmental investigations related to mining developments, power developments, civil engineering projects, landfills, hazardous waste sites and aggregate pits and quarries within North America and Latin America. Examples of specific projects within the mining, power, aggregate and environmental/waste management sectors are summarized below:

**Environmental/Waste Management Sector**

- Project Manager for hydrogeological component of the Interim Waste Authority (IWA) municipal landfill site selection process in the Region of Peel including the selection of the preferred site and supporting documentation;
- Project Manager responsible for a detailed hydrogeological investigation of a large dolostone quarry (Steetley South Quarry) for the development of a 25 million tonne industrial/municipal engineered landfill facility in Flamborough, Ontario including the expert witness testimony in support of the proponents application before the Joint Board of the Ontario Consolidated Hearing Act; and
- Project Manager responsible for characterizing the extent and nature of a large chlorinated solvent DNAPL plume that had migrated 200 m in dolostone bedrock at an industrial site in Niagara Falls, New York and project hydrogeologist for the assessment of PCB contamination (dissolved phase and DNAPL) in fractured dolostones bedrock at Smithville, Ontario.

**Aggregate/Cement Industry Sector**

- Project geologist/hydrogeologist and project director responsible for numerous subsurface investigations of limestone/dolostones resources for use in the aggregate industry and Portland cement industry;
- Projects have included the investigation design and licensing of 60 million tonne limestone aggregate quarry with subsequent monitoring of production at Victoria Road, Ontario for independent owner including successful defence of the



proposal before the Ontario Municipal Board;

- Project geologist/hydrogeologist for the assessment of rock quality and licensing for the expansion and deepening of a limestone quarry from 60 m to 200 m depth for Portland cement production in Bowmanville, Ontario;
- Project geologist/hydrogeologist responsible for geological assessment, aggregate quality and hydrogeological conditions associated with the expansion and deepening of a dolostones quarry in Southeastern Michigan; and
- Project director for geological and hydrogeological assessment of a limestone quarry in Charlevoix, Michigan to determine the potential minable resources for Portland cement production and hydrogeological influences on quarry expansion and deepening.
- Project director for geological and hydrogeological assessment for expansion and deepening of limestone quarries for Portland Cement production in St Marys, Ontario.

**Mining Sector**

- Senior geologist/hydrogeologist responsible for the geological/hydrogeological baseline studies for the Las Bambas project and Antapaccay near Cusco, Peru;
- Senior geologist/hydrogeologist responsible for the geological and hydrogeological assessment of the Conga copper project tailings basin design project near Cajamarca, Peru;
- Senior geologist/hydrogeologist responsible for geological and hydrogeological component of the Environmental Assessment for the Alto Chicoma gold mine development in Peru;
- Senior geologist/hydrogeologist providing technical oversight for the hydrogeological component for the Environmental Assessment of the Koniambo laterite nickel mine development in New Caledonia;
- Senior geologist and hydrogeologist responsible for hydrogeological assessment of tailings basins, waste dumps and open pit for the Voisey's Bay nickel mine project in Labrador, Canada; and presentation of hydrogeological evidence before the Canadian Environmental Assessment Board;
- Project geologist and hydrogeologist responsible for the hydrogeological assessment for development of the Antamina Mine tailings basin in Peru;
- Project hydrogeologist for feasibility study of the El Pachon copper mine development in Argentina;
- Project Manager responsible for a hydrogeological investigation to assess the source of large groundwater inflows to a karstic lead-zinc mine near Gays River, Nova Scotia;
- Project Manager responsible for hydrogeological investigations relating to decommissioning of uranium mine tailings basins in Elliot Lake Ontario; and
- Senior hydrogeologist responsible for the hydrogeological investigation for a 40 million tonne gold tailings basin for the Williams Mine in Hemlo, Ontario including geological mapping, airphoto interpretation, dam site investigations, seepage assessment, bedrock grouting, design and groundwater quality assessment.

**Power Sector**

- Geologist/hydrogeologist responsible for the initial characterization of the subsurface stratigraphic and hydrogeological conditions for the proposed OPG low-level and intermediate level nuclear waste repository feasibility study including the selection of the deep geological repository horizons beneath the



Bruce site in Ontario;

- Project Hydrogeologist responsible for the hydrogeological component of the Canadian Environmental Assessment for the restart of the 2000 MW OPG Pickering A nuclear power station and restart of the Bruce Power 1700 MW Bruce A NPS, Units 3 and 4 and the subsequent Bruce A Units 1 and 2 refurbishing and return to service programs;

- Senior hydrogeologist responsible for Environmental Assessment of the proposed expansion of the OPG Western Waste Management Facility at the Bruce site in Ontario;

- Project Hydrogeologist responsible for the geological/hydrogeological component of the Canadian Environmental Assessment of the proposed nuclear fuel dry storage programs at the OPG Darlington station and Pickering Station;

- Project geologist/hydrogeologist for OPG site selection process for potential host geological strata for siting of low level waste repositories in Ontario;

- Project geologist responsible for successful defence of the Canadian Ministry of Public Works in a class action law suite before a Quebec Superior Court regarding the historical impact of the operation of the Ottawa River Timiskaming Dam; and

- Project hydrogeologist for the evaluation of the use of limestone quarries for engineered disposal of OPG Lakeview station coal ash.



## PROJECT EXPERIENCE – MUNICIPAL AND INDUSTRIAL WASTES

Mr. Blair, a Principal and senior geologist and hydrogeologist in our Mississauga office, oversees field programs for geological and hydrogeological investigations, including the borehole drilling, monitoring well installation, hydraulic conductivity testing, groundwater quality assessment and predict groundwater impacts. Mr. Blair has over 20 years of experience in assessing the hydrogeological conditions of landfill and mining developments including extensive experience in the assessment of existing and proposed quarry developments. He has provided expert hydrogeological testimony before the Consolidated Hearing Board in support of the proposed Steetley South Quarry Landfill development in the Town of Flamborough, and expert hydrogeological testimony before the OMB Hearing Board in support of the Official Plan Amendment 129 for the Lake Wilcox area in Richmond Hill. Recently he has successfully provided expert geological and hydrogeological testing before the OMB Hearing Board for the re-zoning and licensing of a green field limestone quarry.

Mr. Blair was the project hydrogeologist on various solid industrial waste landfill studies, and was directly responsible for carrying out the extensive Peel Region landfill site selection process for the Interim Waste Authority (IWA), investigating the surficial geological deposits in the region and development of geological constraint mapping for the site screening and selection process as well as a detailed assessment of the preferred site. He has become very familiar with the geological/hydrogeological conditions and aggregate resources particularly in Ontario, including:

- Evaluation of the Uthhoff Limestone Quarry in Orillia to determine stratigraphy based on the results of core logging, quarry mapping and delineating specific alkali reactive horizons and zones of groundwater inflow;
- Evaluation of the Burlington Dolostone Quarry to assess depth of reserves relative to underlying shales and nature of formations, potential influence in groundwater levels and groundwater use within surrounding areas associated with expansion of mining;
- Preparation of documentation for Uthhoff, Burlington and Lincoln Quarries for permit application under the Pits and Quarries Act and MOE water taking permits;
- Evaluation of the dolostone quarries in Flamborough, Ontario and EA assessment for landfilling in the South Quarry and aggregate resource evaluation in the North Quarry (Lafarge Canada), and preparation of reports for MOE permit to take water;
- Evaluation of the Cayuga Quarry, Ontario including detailed interpretation of stratigraphic conditions through drilling and quarry mapping, and preparation of documentation for MOE water taking permits;
- Evaluation of Milton Limestone Quarry in Milton, Ontario including extensive drilling for purposes of submitting an application for quarry expansion under the Pits and Quarries Act and MOE water taking permit requirements; and
- Definition of limestone resources, aggregate quality, quarry design and hydrogeological assessment of undeveloped site with developable reserves of 60 Mt located near Fenelon Falls, Ontario. Documentation was prepared for application under the Pits and Quarries Act.



## PROJECT EXPERIENCE – GEOLOGICAL AND HYDROGEOLOGICAL EVALUATIONS

**Uhthoff Limestone Quarry**  
Orillia, Ontario

Geological and hydrogeological evaluation to determine stratigraphy based on the results of core logging and quarry mapping. Emphasis placed on delineating specific alkali reactive horizons within the Gull River Formation and zones of groundwater inflow. Preparation of documentation for permit application under the Pits and Quarries Act and MOEE and quarry mapping.

**Burlington Quarry**  
Burlington, Ontario

Geological evaluation to assess depth of reserves relative to underlying shales and nature of formations. Evaluation of potential influence in groundwater levels and groundwater use within surrounding areas associated with expansion of mining. Preparation of documentation for permit application under the Pits and Quarries Act and MOEE and quarry mapping.

**Lincoln Dolostone Quarry**  
Grimsby, Ontario

Geological evaluation including the definition of deleterious chert horizons through drilling and quarry mapping.

**Redland Dolostone Quarry**  
Flamborough, Ontario

Geological evaluation and EA assessment for landfilling in the South Quarry and aggregate resource evaluation in the North Quarry. Preparation for reporting for MOEE permit to take water requirements including annual reports and development of remedial measures for adjacent domestic well interference.

**Cayuga Quarry**  
Cayuga, Ontario

Geological evaluation including detailed interpretation of stratigraphic conditions through drilling and quarry mapping. Preparation of documentation for MOEE water taking permits.

**Milton Limestone Quarry**  
Milton, Ontario

Geological evaluation including extensive drilling for purposes of quarry expansion application under the Pits and Quarries Act and MOEE water taking permit requirements. Work included both aggregate resource and hydrogeological evaluations.

**St. Marys Cement**  
Bowmanville, Ontario

Project Manager and Hydrogeologist - Responsible for hydrogeological assessment of deepening Bowmanville Quarry to total depth of approximately 180 m below ground surface next to Lake Ontario. Assessment includes evaluation of groundwater inflows, quarry water balance and dewatering requirements.

**Ministry of Transportation**  
Powassan, Ontario

Project Manager - Responsible for assessment of potential influence of construction of Hwy 11 overpass on adjustments town of Powassan Municipal wells.

**Bell Aerospace Textron**  
Niagara Falls, New York

Project Manager - Responsible for the delineation of TLE contaminant plane (DNAPL and LNAPL) in dolostone bedrock. Developed drilling and well installation and established area extent of 2 km long groundwater contaminant plane.

**Ministry of Environment**  
Smith Falls, Ontario

Project Hydrogeologist - Responsible for delineation of a PCB plane (DNAPL and LNAPL) in groundwater in dolostone bedrock.



## PROJECT EXPERIENCE – MINE DEVELOPMENT AND MINE WASTE, MINE DEWATERING, TAILINGS, WASTE DUMPS AND HEAP LEACHING

Technical representation has included mine dewatering assessments, mine groundwater supply development, tailings basin site selection, geological and hydrogeological assessment of tailings basins including overburden, bedrock structures and groundwater regimes, dam foundation structure, seepage evaluation, grouting recommendations, basin water balance, groundwater quality characterization, mine rock/overburden disposal.

**Cerro de Pasco -  
Vulcan Mining**  
Peru

1998 to 2000. Development of mine water balance and characterization of copper solvent extraction acid raffinate disposal facility in karstic limestone terrain.

**San Vicente - SIMSA**  
Peru

2000. Evaluation of high groundwater inflows to underground mine in karstic limestone terrain including development of dewatering scheme.

**Antamina - Compania  
Minera Antamina**  
Peru

1998 to 1999. Geological and hydrogeological evaluation of tailings basin and foundation seepage conditions for 250 m high rock fill dam.

**El Penon - Kvaerner  
Metals**  
Chile

1997. Groundwater Resource Evaluation for water supply development for gold mine in Atacama Desert of Northern Chile, including production well construction and testing.

**Voisey's Bay Mine -  
Teck Corp., Voisey's  
Bay Nickel Col.**  
Labrador, Canada

1996 to 1997. Site selection, geological and hydrogeological assessment of 100 Mt tailings basin for acid generating tailings from nickel/copper massive sulphide deposit and waste rock/overburden disposal evaluation.

**El Pachon - Cambior  
S.A. Pachon S.A.  
Minera**  
Argentina

1995 to 1996. Hydrogeological and dewatering assessment for 800 Mt open pit mine. Engineering geological and hydrogeological assessment of 500 Mt tailings basin for copper mine situated in mountain valleys

**Heirro Mantua, Davy  
International, Minera  
Mantua Inc.**  
Caribbean

1996. Hydrogeological assessment of 7 Mt tailings basin for acid generating tailings from massive sulphide copper deposit. Dewatering assessment of open pit mine.

**Kidd Creek  
Metallurgical Plant -  
Falconbridge**  
Timmins, Ontario

1995 to 1996. Environmental investigation of soil and groundwater conditions and quality beneath 1.5 km<sup>2</sup> milling/smelting/refining plant for Kidd Creek copper zinc massive sulphide mine.

**Aquarius Mine - Echo  
Bay Mines Ltd**  
Timmins, Ontario

1995. Assessment of dewatering requirement for proposed open pit mine to be developed through 50 m to 100 m of permeable sand and gravel deposits.

**Denison Mine -  
Denison Mines Limited**  
Elliot Lake, Ontario

1984 to date. Structural geological and hydrogeological assessment of 66 Mt uranium tailings basin including seepage assessment and groundwater quality evaluation for basin expansion and decommissioning of potentially acid generating tailings.





**Stanrock Mine -  
Denison Mines Limited**  
Elliot Lake, Ontario

1993 to 1994. Structural geological and hydrogeological assessment of 6 Mt uranium tailings basin for evaluation of decommissioning acid generating tailings.

**Quirke Mine - Rio  
Algom Limited**  
Elliot Lake, Ontario

1980 to 1990. Structural geological and hydrogeological assessment of 50 Mt uranium tailings basin expansion including basin geology/hydrogeology and structural evaluation of dam foundations and grouting.

**Macassa Mine - Lac  
Minerals**  
Kirkland Lake, Ontario

1993. Hydrogeological evaluation of 10 Mt gold tailings basin expansion including seepage evaluation of dam foundations.

**Gays River Mine -  
Westminer**  
Gays River, Nova Scotia

1991. Hydrogeological investigation of large volume groundwater inflows to underground zinc mine developed in karst gypsum terrain.

**Williams Mines - Lac  
Minerals**  
Hemlo, Ontario

1983. Hydrogeological investigation of 40 Mt gold tailings basin for potentially acid generating tailings.

## PROFESSIONAL AFFILIATIONS

Member, Association of Professional Geoscientists of Ontario



**Education**

*P.Eng. Civil Engineering -  
Environmental, University  
of Manitoba, Winnipeg,  
Manitoba, 2002*

**Languages**

*English – Fluent*

**Golder Associates Ltd. – Mississauga**

**Employment History**

***Golder Associates Ltd. – Mississauga, Ontario***

*Water Resources Engineer / Hydrologist (2003 to Present)*

Experience in hydrologic and hydraulic modelling, water quality sampling, stream hydrometry, stormwater management, watershed planning, permitting for water taking and off site discharge of effluent waters associated with industrial and commercial operations and water resource management.

***Manitoba Hydro – Winnipeg, Manitoba***

*Hydro Power Planning Department (2001 to 2002)*

Junior engineer working in the Hydro Power planning department. Experience included estimating varying water level elevations within a river system, such as the 10, 25, 50 and 90 percentiles over the past 25 years, computer programming and water elevation monitoring.



## PROJECT EXPERIENCE – WATER RESOURCES

- Water Supply Study  
Halton Region**  
Acton, Ontario, Canada
- Surface water task lead for a project to characterize water resources in the vicinity of a well field in the Regional Municipality of Halton. The project involved completing a water balance of the adjacent lake, and installation of monitoring equipment and flow measurements within streams that contribute to the lake. Bathymetric survey information was used to determine the effect (i.e. drop in lake elevation) due to the proposed increase in water taking during dry periods of the year.
- Guelph Southwest  
Quadrant Class EA**  
Guelph, Ontario, Canada
- The project was a Class EA to conduct an impact analysis of new municipal test wells on local groundwater and surface water resources. Flow monitoring and baseflow assessment was conducted for the Speed River, Hanlon Creek and local tributaries. Flows were monitored during a pumping test on the municipal test wells to assess potential effects relating to the increase in pumping.
- Cement Kiln Dust  
Landfill**  
Bath, Ontario, Canada
- Project manager for a project, which requires an annual report to the Ministry of the Environment (MOE), and involves groundwater and surface water quality and flow monitoring. The groundwater quality was compared to Guideline B-7 for contaminated sites which are based on the water quality from an upgradient well. The surface water quality results were compared to Provincial Water Quality Objectives (PWQO). The work program also involved a drilling program.
- Stormwater Control  
Study**  
Sarnia, Ontario, Canada
- Prepared a Stormwater Control Study to assess the effectiveness of proposed alterations to the existing stormwater management facilities. A hydrological model, Visual OtHYMO V.2.0, was used to estimate the runoff volume for various storm events which were compared with the available storage within the stormwater facilities.
- CSA Mine - Stormwater  
Management Plan**  
New South Wales,  
Australia
- A stormwater management plan was completed for the CSA copper mine in Cobar, NSW Australia. The site experiences significant erosion during flash floods. Due to the heat and drought conditions vegetation was not a feasible option for bank stabilization. Other options were explored such as rock check dams and flow dissipators at culvert discharges.
- Hydrological Study for  
Shale Quarry**  
Niagara, Ontario,  
Canada
- A hydrological study was completed which included water balances for various phases of mining and estimating the runoff volume within the quarry due to a 2 year 24 hour storm event. The runoff volume from the 2 year 24 hour storm event was used to determine an appropriate discharge rate for dewatering the quarry sump within a few days. Water quality samples from the existing sump were taken and compared to Provincial Water Quality Objectives (PWQO) and Canadian Irrigation Guidelines since the site water is used by a neighboring farmer for crop irrigation.



**Permit To Take Water,  
Certificate of Approval  
Applications and Pump  
Calibration**  
Manitoulin Island,  
Ontario, Canada

Completed a pump calibration for the site using a Controlotron pipe flow meter. Based on the pump calibration and water taking criteria within the MOE Permit to Take Water Manual, an application for a Permit to Take Water was submitted for the site. The site required two Certificates of Approval for discharge; one approval was for seeps through the perimeter dam of a wash plant pond and the second one was for the quarry sump discharge. For the first Certificate of Approval the operation of the aggregate processing system was investigated and sub-watershed areas were delineated to determine the amount of area contributing to the wash plant ponds. The storage volumes of the existing wash plant ponds were determined. A water balance was completed for the wash plant system to estimate the amount of water lost due to the seeps. Other areas of water loss that were considered within the water balance included evaporation and moisture retained in the aggregate product. For the second Certificate of Approval a conceptual design of a hybrid wetland was developed to treat the quarry discharge water for Total Suspended Solids and trace amounts of ammonia resulting from blasting residues.

**Certificate of Approval  
Application for Oil  
Distribution Company**  
Toronto, Ontario,  
Canada

The discharge water from an existing oil-water separator contained oil and grease and high Total Suspended Solids concentration. To determine if the site was self contained in case of a spill, a drainage plan of the site was developed based on the connections of the underground pipe system. Measurements and video were taken of the existing oil-water separator but a manufacture name and number were not available. To determine if oil-water separator was working efficiently water quality samples were collected. Based on water quality results a new oil-water separator was sized and installed.

**Credit Valley  
Conservation Authority  
Floodline Mapping**  
Mississauga, Ontario

Previous HEC-2 models that represented three different reaches along the Credit River were combined to create one HEC-RAS model for the entire area. The HEC-RAS model structures were updated using As- Built drawings and survey information. Floodline mapping along a portion of the Credit River for the Regional and 100 year 24 hour storms were plotted using the HEC-RAS model results.

**Flood Risk  
Management Study -  
Marrickville City  
Council**  
Sydney, Australia

A Flood Study and Flood Risk Management Study was completed for Marrickville, Sydney NSW. The study involved modelling of the stormwater infrastructure and overland flow paths for various return period events. As part of the study community consultation played a key role in exploring options for stormwater containment and Water Sensitive Urban Design.

**Flood Risk  
Management Study -  
Gosford City Council**  
Gosford NSW, Australia

A Flood Study and Flood Risk Management Study were completed for the city of Gosford. The study involved the creation of a hydrological model for the upstream catchment to estimate flood levels within the main river and local streams for various return periods. Main stormwater infrastructure was modelled using TUFLOW to determine overland flow paths and flood prone areas within the city. As part of the flood study a community survey was released to obtain information of flood prone areas and to gain understanding of residents that experience flooding on their property on a regular basis. Options were provided to the city council for stormwater management improvements to reduce flooding.



**CP Rail Culvert Design**  
London, Ontario,  
Canada

An existing concrete culvert under a CP Rail line required repairs or replacement. To determine if the size of the existing culvert was sufficient to convey the runoff from the surrounding drainage area a hydrological modelling, Visual OtthYMO V.2.0, was used to estimate the 100 year and 50 year 24 hour runoff volumes and flows. HydroCulv v1.2, a hydraulic culvert model, was used to analyze the existing culvert and design proposed replacement culverts

**Tractive Force  
Analysis and  
Hydrological Report**  
Ottawa, Ontario, Canada

A survey of an eroding stream receiving quarry discharge water was completed to conduct an erosion assessment. The survey data was modelled in HEC-RAS to estimate the bankfull flow and tractive forces within the receiving stream and the model results were compared to the existing discharge rate. To estimate the critical tractive force at which erosion occurs, bed and bank surficial soil samples were taken and analyzed to determine the grain size distribution of the soil. A comparison of pre-development and existing conditions was completed to estimate the pre-development runoff volume/flow for various storm events into the receiving system compared to the existing conditions runoff volume/flow. To complete the hydrologic assessment, various design storms were modelled using Visual OtthYMO V.2.0 for both pre-development and existing conditions.

**Tractive Force  
Analysis**  
Nobleton, Ontario,  
Canada

As part of a hydrological study for a new development a survey of the receiving stream was conducted, which included five cross sections and the stream profile. The survey data was modelled in HEC-RAS to estimate the bankfull flow and the tractive forces within the existing channel. To estimate the critical tractive force at which erosion occurs, bed and bank surficial soil samples were taken and analyzed to determine the grain size distribution of the soil.

**Certificate of Approval  
Application for a  
Ready-Mix Site**  
Toronto, Ontario,  
Canada

The discharge water from a Ready-Mix site within Toronto was exceeding recognized guidelines for Total Suspended Solids. In order to reduce the amount of discharge water and to improve discharge water quality, a grading plan of the site was developed and options to recycle acid treated water were discussed with the client and implemented. Some of the recommended options included: minimizing/eliminating side tank overflow, re-using acid treated water in the concrete mixture, re-use of the water to wash trucks, design additional holding cells or a sump to contain runoff during a storm event.

**Hydrological Study for  
Quarry License  
Application**  
Dundas, Ontario,  
Canada

As part of a quarry license application a monitoring program was completed which included monthly flow measurements, quarterly water quality sampling and level logger transducer downloads. The monitoring data and survey data were used to develop rating curves using HEC-RAS. Water balances for various phases of development were completed within the groundwater model boundary. The estimated infiltration rates were provided to the hydrogeological group for input to a groundwater model. For comparison to the water balance average annual surplus estimations, available stream gauge data from Water Survey of Canada within the receiving streams were prorated to the model boundary.



**Hydrological Study for  
Open Pit License  
Application**

Paris, Ontario, Canada

As part of an open pit license application water balances of the site area were completed for various phases of development. Infiltration rates for the various land uses and soil types were estimated using the Ministry of Environment (MOE) Stormwater Management, Planning and Design Manual (2003). The infiltration rates were used in conjunction with the hydrogeological group to calibrate a groundwater model. The license application also involved a monitoring program of four locations including flow measurements and water quality sampling. Due to the surrounding environment and a low depression within the site, hydrological modelling of the upstream catchment area was completed to assist in the design of an open channel ditch which will direct off-site runoff around the proposed quarry.

**Permit to Take Water  
Category 3**

Ottawa, Ontario, Canada

A survey of the stream, on-site flow measurements and staff gauge readings were used to develop a rating curve at the point of taking for a golf course. The survey of the stream was modelled in HEC-RAS to develop a rating curve. A critical depth within the stream was identified by Golder Biologists based on plant life and fish habitat. The golf course management will use the rating curve and readings from the installed staff gauge to determine if pumping is allowed based on the depth of the stream at the point of taking.

**Flow Monitoring and  
Quarry Water Balance**

Burlington, Ontario

Conducted streamflow measurements at various locations for a confidential client in a catchment area in Southern Ontario as part of a study on the environmental effects of quarry expansion. A water balance for the proposed quarry was developed, which included watershed delineation and a land use study.

**Water Quality, Flow  
Monitoring and Rating  
Curve Development**

Hagersville, Ontario

Conducted streamflow measurements and water quality sampling at various locations along Boston Creek as part of an on-going investigating of the potential influences of a local underground mine. Using the stream flow measurements and staff gauge readings, rating curves and flow hydrographs were developed at three locations along Boston Creek.

**Certificate of Approval  
Application**

Perth, Ontario

Prepared an application for a new Certificate of Approval (sewage) for Omya Canada Inc. The work included compiling information regarding local hydrology, stormwater drainage configuration and stormwater management pond design. Modelling using Visual OttHymo v.2.0 was used to estimate surface water runoff from each catchment area into the various ponds on the site. The modelling results were used in the design of a downstream settling pond. Estimated mean monthly flow rates were pro-rated from an Environment Canada Stream gauge.

**Open Channel Design**

Belleville, Ontario

A ditch to contain leachate from a landfill and direct it to a catch basin was designed. The design encompassed pipe and catch basin design as well as determining which geo-textile filter cloth and rip-rap size was appropriate for the design. Ditch invert elevations were designed to minimize inundation during high Lake Ontario water level events.



**Mavis Road – Grading  
Plan and Stormwater  
Pond Design**  
Mississauga, Ontario

A grading plan to re-direct flow was developed. Storm Water Management practices were put into place which included grass swale design, vegetative buffer strips, wet pond design and design of a Storm Water Management (SWM) Cell for recycled water. The drainage areas were delineated and runoff rates and volumes were estimated using Visual OttHymo v2.0.

**Surface Water  
Investigations**  
Hamilton, Ontario

Water quality sampling and Storm Event sampling of a wetland area surrounding a closed landfill was conducted. Rating curves were developed for two locations along the stream running through the wetland area. A water balance was completed for the area which included watershed delineation and a land use study. Modelling using Visual OttHymo v2.0 was completed to estimate surface water runoff from the landfill area. Estimated mean monthly flow rates were pro-rated from an Environment Canada Stream gauge for the sub- catchment areas surrounding the landfill.

**Bruce Power  
Temperature Plume  
Program**  
Tiverton, Ontario

Temperature loggers were deployed at 21 locations along the Lake Huron coast line to measure thermal plumes and background temperature variations adjacent to the Bruce Power generating station. The information from the temperature loggers was downloaded three times during the study period. A water quality sampling program at the same locations was conducted at the same time the temperature loggers were downloaded to explore the potential effects of water temperature on bacterial activity.

**Existing Water  
Elevations for Mode of  
Operations**  
Winnipeg, Manitoba

Created graphs using Microsoft Excel and water elevation data from Manitoba Hydro's database and completed percentiles for a mode of operations study at 5 different locations. Fortran and Basic algorithms were created to calculate the percentiles. The water elevation data extended over a period of 25 years. Some locations did not have a water elevation gauge, therefore the elevations were to be determined using the standard step method. This project was then used to describe what the water levels have been in the past, and what the 10, 25, 50 and 90 percentiles were over the past 25 years, to Environmental Scientists, Management and the Native Reserves.

**Redland Brow Landfill  
– Water Quality**  
Dundas, Ontario

Collected surface water quality samples on a closed landfill as part of on-going monitoring of site conditions. Samples were collected using standard field protocols required for comparison to the Provincial Water Quality Objectives (PWQO) standards.

**Permit to Take Water**  
Orillia, Ontario

Conducted a pump calibration test, compiled documentation and wrote a report in support of a Permit to Take Water application for the Nelson Uthhoff Quarry.





**Aquafarms '93 Water  
Balance**  
Feversham, Ontario

Stream flow monitoring and survey data were collected on site. Stream flow from a stream gauge monitored by Environment Canada was used to estimate flows of the catchment area upstream of the site. A water balance was developed for two specific areas that were being studied. The water balance included delineating water sheds, a land use study and interpretation of water budget information provided by Environment Canada.

**Pump Calibration for  
Quarry**  
Ottawa, Ontario

Conducted a pump calibration test for Lafarge Bearbrook Quarry. Three types of measurements were used for comparison of results; area velocity measurements, trajectory methods and full pipe flow measurements.

## PROFESSIONAL AFFILIATIONS

Professional Engineers of Ontario;



**Education**

*M.Sc. (Eng.) Water Resource Engineering, University of Guelph, Guelph, 1995*

*B.Sc. (Eng.) Water Resource Engineering, Minor: Environmental Engineering, University of Guelph, Guelph, 1993*

**Languages**

*English – Fluent*

**Mississauga**

**Kevin M. MacKenzie M.Sc. (Eng.) P.Eng. Water Resources Engineer**

Mr. MacKenzie joined Golder Associates in 1997. Principal responsibilities include hydrologic and hydraulic modelling, design of hydraulic structures and erosion control measures and providing technical water resources support for a wide variety of environmental studies. Project experience includes unsteady hydraulic modelling of mixed sub and supercritical flood waves, prediction of flood flows from extreme design storms, flow monitoring and rating curve development, regional hydrological analyses, water budgets and balances, water management planning and consideration of fluvial geomorphology and ecological principles in design. Water resources work has been completed for clients in the Power Generation, Power Transmission, Aggregate and Mining Sectors as well as Regional Government Agencies and Environment Canada. Prior to joining Golder Associates, Mr. MacKenzie was involved in water resources research for four years, as part of his graduate studies, then as a research associate at the University of Guelph. Mr. MacKenzie has an excellent understanding of a wide variety of hydrology, hydraulics, soil erosion and fluvial geomorphology disciplines.

**Employment History**

**Golder Associates Ltd. – Mississauga, Ontario**

*Water Resources Engineer, Associate (1997 to Present)*

Responsible for management of water resources assessments including hydrology, hydraulics, upland and in-stream erosion, water quality and water management for a wide variety of government, power generation, industrial, mining and aggregate producing clients. Being part of a comprehensive client service team for aggregate producers in Ontario has facilitated an excellent understanding of the aggregate business and how water management affects their operations. Water resources assessments have been completed in support of Environmental Assessments (EA) and Permitting and Approvals under Federal, provincial and international regulations. Peer reviewer for two Ontario Source Water Protection projects and water resources sections of a new international airport in Quito, Ecuador. Responsible for managing and implementing field data collection studies, including stream flow monitoring, meteorology and water quality. Other abilities include assessments of upland soil erosion, natural channel design and fluvial geomorphology.

**University of Guelph – Guelph, Ontario**

*Hydrologist (1996 to 1996)*

Responsible for collection and analysis of four large databases of rural hydrology parameters in Southern Ontario. Frequency distributions were found for event, daily and yearly runoff coefficients and detailed daily water budgets were synthesised for the duration of each record. Estimated evapo-transpiration in the absence of meteorological data required for the Penman equation. These estimates were obtained using a modification of the Blaney and Criddle equation.



***University of Guelph – Guelph, Ontario***

*Research Assistant (1994 to 1996)*

Responsible for designing and performing experiments concerning soil erosion by rainfall. Erosion rates from single drop impacts and 1.0 m<sup>2</sup> erosion plots were quantified and related to rainfall intensity and energy flux rate. A model of the inter-rill detachment process was developed for use in future large scale erosion models.

***University of Guelph – Guelph, Ontario***

*Teaching Assistant (1994 to 1996)*

Taught weekly seminars on engineering mechanics (statics and dynamics) and on engineering design and report writing. Emphasis was placed on three dimensional vector analysis and excellence in communicating technical information through text and verbal presentations.



## PROJECT EXPERIENCE – SOURCE WATER PROTECTION

**Source Water Protection: Peer Reviewer York Region Tier 3**  
Southern Ontario, Canada

Peer reviewer for the surface water components of the ongoing York Region Tier 3 water budget and water quantity risk level assessment for the Stouffville area. The project team is proposing to use GSFLOW to model both the surface and groundwater systems. GSFLOW is an integrated surface and groundwater hydrology model developed by the US Geological Survey, based on MODFLOW and PRMS components. The study area is complex as it includes the southern flank of the Oak Ridges Moraine and straddles the divide between Lake Ontario and Lake Simcoe. Stouffville is in the headwaters of the Rouge River watershed.

**Source Water Protection: Peer Reviewer Halton Tier 3**  
Southern Ontario, Canada

Peer reviewer for the surface water components of the ongoing Halton Region Tier 3 water budget and water quantity risk level assessment for the Georgetown and Acton areas. The project team is using PRMS and MODFLOW to model surface and groundwater hydrology respectively, with an option to combine the models into an integrated surface and groundwater model using GSFLOW. The study area is complex as it includes the Niagara Escarpment, the Acton re-entrant valley and several buried bedrock valleys which are believed to play an important role in delivering groundwater to the area. The study area also straddles the divide between the Grand River and Credit River watersheds.

**Source Water Protection: Peer Reviewer Orangeville Pilot Tier 3**  
Southern Ontario, Canada

Peer reviewer for the surface water components of the ongoing Orangeville Pilot Tier 3 water budget and water quantity risk level assessment. The project team is using HSPF and MODFLOW to model surface and groundwater hydrology respectively. The study area is complex as it includes the Niagara Escarpment and the Oak Ridges Moraine. The study area also straddles the divides between the Grand River, Credit River and Nottawasaga River watersheds.

**Source Water Protection: Peer Reviewer CTC Tier 1 and Tier 2**  
Southern Ontario, Canada

Peer reviewer for the surface water components of the Tier 1 and Tier 2 water quantity stress assessments for the CTC Source Protection Region, which includes the Credit River (CVC), Toronto Region (TRCA) and Central Lake Ontario (CLOCA) watersheds. Data availability and modelling approaches used by the different conservation authorities and their consultants varied across the CTC region.

**Source Water Protection: Lower Speed River (Guelph) Tier 3**  
Southern Ontario, Canada

Golder Associates teamed with AquaResource to complete a Tier 3 water budget and water quantity risk level assessment for the Lower Speed River watershed. The study area includes the City of Guelph, part of Cambridge and contributing drainage and recharge areas located north and east of Guelph. An extensive baseflow survey was conducted across the study. Baseflow was measured at thirty two locations during the spring, summer and autumn of 2008. This information was used to estimate varying groundwater discharge and recharge rates to support definition of boundary conditions for the groundwater model.

**Source Water Protection: Nickel District CA Valley East Tier 2**  
Northern Ontario, Canada

Senior technical advisor for the Valley East Tier 2 water quantity stress assessment. The City of Sudbury draws drinking water from several wells located in the Valley East area. Worked with project team to identify a modelling approach that would make the best use of, sometimes limited, existing data. The Tier 2 results have led to the initiation of the Tier 3 Local Area Water Budget for the groundwater supply in Valley East, which is currently being initiated.



**Source Water  
Protection: Ramsay  
Lake Tier 1 and Tier 2**  
Sudbury, Ontario,  
Canada

Senior technical advisor for the Ramsay Lake Tier 3 water budget and water quantity risk level assessment. The City of Sudbury draws water directly from Ramsay Lake for part of its drinking water supply. Ramsay Lake and its contributing drainage areas are being modelled using HEC-HMS (Hydraulic Engineering Corps – Hydrological Modelling System). Based on existing information, it appears that the hydrology of Ramsay Lake is dominated by surface water inputs and as such, there is no plan to include groundwater modelling at this time. HEC-HMS will be used to complete the risk level assessments. Additional field data collection has been initiated to fill existing data gaps regarding key inflows to the lake and the outflow adjacent to Science North.

**Source Water  
Protection: Bronte  
Creek**  
Southern Ontario,  
Canada

Golder Associates were commissioned to undertake a Threats Assessment of a potential intake at Bronte Creek. Mr. MacKenzie directed the project for Golder. The intake, intended to deliver surface water to a small water treatment plant, was identified as one potential alternative for providing a drinking water supply to nearby residential properties possibly affected through the construction of an adjacent quarry. The Threats Assessment identified eleven water quality issues at the potential intake location, attributing causes to a number of likely contaminant sources throughout the watershed. In accordance with MOE Draft Guidance Modules, the work undertaken as part of this assessment included stakeholder liaison, hydraulic modelling, IPZ delineation, vulnerability analysis, the compilation of issues and threats inventories and a description of data knowledge gaps. Should surface water abstraction from Bronte Creek be identified as the preferred alternative for providing long-term drinking water supply, this Threats Assessment report will provide the basis for the Tier 2 assessment.

**Source Water  
Protection: Timmins  
IPZ Study**  
Northern Ontario,  
Canada

An Intake Protection Zone (IPZ) and the vulnerability scores for the City of Timmins drinking water treatment plant on the Mattagami River were assessed. The delineation of the IPZ included the consideration of river flow conditions, influences of dam operation, location of significant potential upstream sources of contamination, local transportation routes, storm sewer drainage patterns and the behaviour of spills in the river. The project also included the collection of site specific data through a field program. The field program used non-conventional methods to measure travel time due to restrictions on the use of dye tracers in the river because of the presence of private drinking water intakes. The field program collected detailed velocity data that was used to estimate dispersion and to calibrate a HEC-RAS model that was used to predict the travel time under various flow conditions.

## PROJECT EXPERIENCE – WASTE MANAGEMENT

**Edgewood Landfill  
Monitoring**  
Flamborough, Ontario,  
Canada

Designed and implemented a flow and water quality monitoring programme to assess potential historic effects of watercourses surrounding the closed Edgewood Landfill site in Flamborough Ontario. This work was completed as part of an inventory and assessment of historic landfill operations in the City of Hamilton.



**Bath CKD Landfill Design and Monitoring**  
Kingston, Ontario,  
Canada

Monitored existing water quality and flows associated with an existing Cement Kiln Dust landfill. Designed stormwater control measures for design of a new landfill cover for the existing landfill as well as four new cells to increase the capacity of the landfill.

**Brow Landfill Storm-water Management Plan**  
Flamborough, Ontario,  
Canada

Developed a storm-water management plan to address drainage requirements for the site and mitigation measures required to control potential impacts as part of the closure process. Designed drainage channels, a stormwater management pond, hydraulic flow control structures and a drop structure to safely convey stormwater over the edge of the Niagara Escarpment into a purpose designed plunge pool.

**Adams Mine Landfill**  
Kirkland Lake, Ontario,  
Canada

Completed a baseline hydrology assessment including flow and water quality monitoring as part of an investigation into the feasibility of a proposed land-filling operation at Adams Mine. Monitoring included flow measurements from boats in medium to large rivers.

## PROJECT EXPERIENCE – HYDROLOGY/HYDRAULICS

**Quarry License Expansion**  
Southern Ontario,  
Canada

A level II hydrogeology study was completed in support of a rock quarry license expansion application. The surface water component of the study included establishment of eight continuous stream flow gauges and associated baseflow separation analysis. The baseflow separations were used to estimate mean annual recharge to groundwater. This information was provided to Golder hydrogeologists for use in estimating boundary conditions for the FEFLOW groundwater model. In addition, monthly and annual surface water balances were modelled using the Thornthwaite Water Budget method coupled to a GIS procedure. The fraction of surplus water that infiltrates was estimated using GIS and the method outlined in MOE 2003. The infiltration estimates were initially assumed to equal recharge. The resulting modelled groundwater levels were reviewed to identify areas of upward gradient or minimal downward gradient. This information was used in subsequent iterations to adjust the recharge estimates.

**Quarry License Expansion**  
Northern Ontario,  
Canada

A level II hydrogeology study is underway in support of a rock quarry license expansion application. Surface water features in the area are characterized by shallow intermittent streams flowing on top of bedrock above a small escarpment running through the site. Below the escarpment, there is a line of small watercourses connecting a series of small lakes. The surface water study includes monitoring of several of the small intermittent watercourses and the outlet of two of the small lakes. PRMS (Precipitation, Runoff, Modelling System) is being used to model the surface hydrology. The results of this analysis will form input to the groundwater modelling discipline. Recharge will initially be assumed to equal infiltration in the groundwater model, however, we expect this will cause mounding in parts of the model. Further iterations will be used to calibrate the recharge estimates subject to a mass balance at the surface.



**Aggregate Site Water Use Study**

Southern Ontario,  
Canada

Participated in a “typical water use” study for the aggregate industry. The study was initiated by the Aggregate Producers Association of Ontario (now the Ontario Stone Sand and Gravel Association) in preparation for planned changes, by the MOE, to the Permit to Take Water application process. Changes to the process were anticipated to include charges for water taking or use. The MOE was simultaneously working on new Source Water Protection legislation. As a result, the APAO felt it would be prudent to quantify actual water use versus maximum permitted water taking rate and to illustrate typical water use at aggregate sites.

**Aggregate Site Permitting**

Southern Ontario,  
Canada

Application packages including MOE application forms and supporting studies and reports have been prepared for numerous aggregate sites across Southern Ontario. Applications have been completed for Permits to Take Water (PTTW) to allow quarry dewatering and for Certificates of Approval (C of A) under Section 53 of the Ontario Water Resources Act to allow offsite discharge of quarry and storm water.

**Simcoe County Groundwater Studies**

Simcoe County, Ontario,  
Canada

A base flow survey was conducted to quantify groundwater discharge in a series of watershed in Simcoe County. The project was conducted in two phases, one for North Simcoe and one for South Simcoe. Water budget and average annual infiltration calculations were completed in support of groundwater modelling. Surface-groundwater interactions were estimated throughout the region to provide a water balance.

**Hydrology Studies for Quarry Developments**

Ottawa Region, Ontario,  
Canada

A series of water resources investigations were completed for aggregate producing clients in the Ottawa area. The studies were completed in support of Certificate of Approval applications made under Section 53 of the Water Resources Act. Each study included a water balance analysis for the quarry and an estimate of future quarry discharge rates. These data were used to estimate the effects of quarry development on downstream water resources.

**Water Supply Studies**

Sudbury, Ontario,  
Canada

Two municipal water supplies were investigated as Groundwater Under Direct Influence of surface water (GUDI). Surficial water resources were investigated and a water balance was prepared in support of groundwater modelling studies.

**Pipeline Corridor Investigations**

Timmins, Ontario,  
Canada

A pipeline was proposed to slurry tailing from the Kidd Metallurgical Site to the Kidd Mine, approximately 35 km away. The tailings are to be used for paste back-filling of depleted areas of the underground mine. An environmental review of water resources along the proposed pipeline corridor was completed. Larger watercourse crossings were mapped and directional drilling was proposed to mitigate environmental effects.

**Hydrological Effects Assessment**

Hagersville, Ontario,  
Canada

A long term field monitoring programme was designed and implemented to track changes in flow regime resulting from closure of an underground Gypsum mine. Part of the mine was closed and allowed to flood. Three flow monitoring stations were established in Boston Creek, which flows over the mine. The stations were selected to represent background conditions upstream of the mines influence, conditions above the mine and downstream of the mine influence. Data loggers and transducers were installed to continuously (hourly) record water levels and flows in the creek.



**GORO Nickel Mine**  
New Caledonia, Canada

The GORO Nickel mine is located in an area of extreme precipitation. Hydrological and preliminary erosion assessments were completed in support of mine development planning and design. These data were used, by the multi-disciplinary project team, to design tailing basin capacities, diversion ditches and dams.

**Round Lake Water Level Control Study**  
Engelhart, Ontario, Canada

Flow exiting Round Lake flows down several kilometres of a very mild sloped reach of the Blanche River before cascading down a set of rapids at a rock outcrop. The rock outcrop was historically blasted to facilitate log driving practices. This modification has caused large fluctuations in water levels in Round Lake and the Blanche River. A hydrological and hydraulic study of the river and lake were completed and a fish-friendly rock-fill weir was designed to stabilise water levels.

**Bruce Nuclear Generating Station**  
Bruce County, Ontario, Canada

Participated in background water quality assessments in the surrounding environment. This work included water quality sampling in Baie du D'Or and Lake Huron. The data were used to assess potential effects of the generating station on the quality of surrounding water resources.

**Pickering-A Nuclear Generating Station**  
Pickering, Ontario, Canada

A multi-disciplinary environmental assessment was completed for the re-start of four CANDU reactors at the Pickering A generating station. A comprehensive review of existing water quantity and quality data was completed. Potential effects, of operating the station, on surrounding water resources were identified and evaluated.

**Voisey's Bay Nickel Mine**  
Voisey's Bay, Labrador, Canada

A theoretical tailings dam breach was investigated using DAMBREAK to quantify potential impacts on an environmentally sensitive creek. Flood passage downstream of the breach was complicated by several small ponds and alternating sub and supercritical river reaches. Proposed mining operations at the Voisey's Bay nickel deposit require extensive management of surface waters. Five small dams were considered to safely convey clean water around the proposed tailings facility and to contain and treat tailings water. Modelling and design of the reservoirs and outflow structures was completed using GAWSER.

**Falconbridge Smelter Area Closure**  
Falconbridge, Ontario, Canada

Performing a detailed analysis of water quantity and quality to address potential long term impacts of the closure on the watersheds of Coniston and Emery Creeks. A daily water budget and reservoir routing model was implemented on a spreadsheet to investigate the efficiency of a variety of different closure scenarios. Also involved in hydrometry, automated water level monitoring, water quality sampling, hydrologic modelling.

**Fire Water Intake**  
Blind River, Ontario, Canada

Alternative designs for a fire water intake structure modification were assessed to minimise maintenance and sediment deposition and increase safety. Two dimensional finite element flow modelling of the intake environment and one dimensional, coupled, unsteady, sediment and hydraulic modelling of the river reach was completed. Modelling results indicated that relocating the intake structure would reduce the risk of failure resulting from sediment accumulation.

**Brimley Road Slope Failure**  
Toronto, Ontario, Canada

Detailed statistical analysis of the rainfall amounts in the 30 days prior to a major slope failure. Historical records of rainfall and snow-melt were analysed and compared to the precipitation in the days preceding the failure.



**Asacha Gold Mine**  
Russia, Russia

The Asacha gold mine lies close to the divide between a pristine watershed and a partially developed watershed. Hydrologically modelled areas potentially affected by mining operations to aid in developing a safe and detailed water management plan.

## SUPPLEMENTAL SKILLS

### **Soil Erosion**

*Upland inter-rill soil erosion by rainfall impact; Upland soil erosion by concentrated flow in rills and gullies; In stream, bed and bank erosion and transport.*

### **Hydrology**

*Stream-flow monitoring and hydrometry; Hydrologic modelling and calibration for event and continuous simulations; Potential and actual evapo-transpiration estimates; Single station frequency analysis; and Water balance calculations.*

### **Hydraulics**

*Sediment transport hydraulics; Velocity profiling; Flood-wave routing in complex channels; Channel erosion potential analysis, including tractive force indices; and Hydraulic design of water management structures.*

### **Fluvial Geomorphology**

*Initiation of sediment movement; Constructed bed-form frequency and channel stability issues; Channel plan-form and section morphology; Impacts of sediment transport on channel morphology and Stream form classification using the Rosgen Classification Scheme.*

## PROFESSIONAL AFFILIATIONS

Professional Engineers Ontario

## PUBLICATIONS

### **Other**

S. I. Ahmed, R. P. Rudra, B. Gharabaghi, K. Mackenzie, and W. T. Dickinson, "Within-Storm Rainfall Distribution Effect on Soil Erosion Rate," *ISRN Soil Science*, vol. 2012, Article ID 310927, 7 pages, 2012. doi:10.5402/2012/310927.

Mackenzie, Kevin (2009) Industrial Wastewater Approvals. Canadian Environmental Compliance Conference and Trade Show (CANECT). Metro Toronto Convention Centre, April 2009.

Mackenzie, Kevin (2007) Industrial Wastewater Approvals. Canadian Environmental Compliance Conference and Trade Show (CANECT). Metro Toronto Convention Centre, April 2007.

Mackenzie, K.M., R.P. Rudra and W.T. Dickinson. 1996. Modelling the inter-rill



detachment process: Some considerations for improving model results. ASAE Paper No. NABEC96-94, Amer. Soc. Agr. Engr., St. Joseph, MI.

Mackenzie, K.M., R.P. Rudra and W.T. Dickinson. 1995. The effect of temporal distribution of rainfall on inter-rill detachment. ASAE Paper No. 95-2378, Amer Soc. Arg. Engr., St. Joseph, MI.



**Education**

*H.B.Sc. Earth Science  
Hydrogeology Honours  
Program, University of  
Waterloo, Waterloo,  
Ontario, 1996*

**Mississauga**

***Global Construction Materials Sector Leader***

David is an Associate with Golder and a Senior Hydrogeologist/Geologist and Project Director with more than 18 years of experience in the cement and aggregate industries. David's current project related responsibilities include geologic and hydrogeologic evaluations of pits and quarries in Canada and internationally. Specific project involvement includes: project director and senior reviewer for multi-disciplinary licensing projects; aggregate quality and resource evaluations; site selection and due diligence studies; hydrogeological assessments, such as water supply, well interference assessments and dewatering issues for quarries and mines.

David's primary responsibility is acting as Golder's Global Construction Materials Sector Leader, a role that includes providing leadership and business development in this sector internationally. Since joining Golder David has grown the sector substantially and has raised Golder's profile in the industry, such that Golder is now known across North America and in other countries as a company with industry leading multi-disciplinary experts who understand our clients' requirements.

One of the reasons David has been successful in this role is based on his experience prior to joining Golder where David worked with Lafarge Canada Inc. as a Land & Resource Manager. During this role his primary responsibilities included looking for, acquiring and permitting new resources for the company. David's ability to understand the operational perspective was a key to his success in building a cooperative relationship across groups (Operations, Sales, Environment and Land).

Currently David sits on the Board of Directors for the Ontario Stone, Sand and Gravel Association where he contributes to the direction of the association by providing insights into the regulatory framework and various technical standards in the fields of geology and hydrogeology and is acting Chair of the Water Committee.

David has also been recognised as an expert in the field of hydrogeology and geology and has testified in front of the Ontario Municipal Board in these disciplines.

**Employment History**

***Golder Associates Ltd. – Mississauga, Ontario***

*Senior Geologist/Hydrogeologist & Aggregate, Ready Mix, Asphalt & Cement Sector Leader, Associate (2007 to Present)*

Responsibilities include geologic and hydrogeologic evaluations in Canada and internationally both as a Senior Geologist/Hydrogeologist and as a Project Director. Additional responsibilities include providing leadership and business development within Golder's Construction Materials sector internationally. Specific project involvement includes: project director for multidisciplinary



licencing projects; aggregate quality and resource evaluations; site selection and due diligence studies for the aggregate industry; hydrogeological assessments such as water supply, well interference assessments and dewatering issues for quarries and mines.

**Lafarge Canada Inc. – Concord, Ontario**

*Resource and Land Manager (2003 to 2007)*

Resource Manager for Southwest Ontario involved in the property and resource management of 49 active and inactive aggregate properties. This role included working with both the corporate office at Lafarge and individual plant operations, and balancing the needs of both. Specific experience within Lafarge included:

Working with the Regional Geologist in the development of short and long term strategies relating to mining plans, including the assessment of extraction strategies for licenced and unlicensed properties, overburden storage, progressive rehabilitation etc.

Development of greenfield site selection criteria for purchase of strategic landholdings in both current and future market areas.

Geological mapping of quarry faces in order to define mining benches based on quality parameters within the geological units. The results of the mapping was then utilised within a geological model to develop a long-term mining strategy for the quarry over the next 25 years. Verification of the geological mapping was carried out through comparison of previous quality testing results from the entire geological sequence being mined. The new mining benches will result in a superior quality end-product and a reduction in potential claims for quality issues.

Involvement in Lafarge Performance Evaluation Reviews for various processing plants within the company. Involvement in these PERs came in the form of providing geological knowledge of the deposit and how the processing plant and those operating it can best utilise this geological information to optimise the operation.

The evaluation of water consumption within representative pit and quarry properties owned by Lafarge in order to address new regulatory requirements being introduced by the Ministry of Environment in Ontario – this work was carried out in conjunction with the Tech Services Group.

Assessment of Permits to Take Water, groundwater monitoring programs and other hydrogeological impacts of mining various deposits.

Assembling lands in several jurisdictions, using agents and lawyers to maintain confidentiality.

Manage greenfield lands, through leases, property management professionals etc

Secure planning and licence approvals by managing work programs for agency and public consultation.



Coordinate multi-disciplinary teams of independent professionals for licence applications.

Liaise with peers and operations/marketing on other development projects in business unit.

Present reports/presentations to senior management.

Manage local and provincial contacts relevant to approvals.

Manage neighbour relations during mining activities and approvals process.

Management of new licence applications on various sites. These licence applications involve the identification of technical requirements and the organisation and management of multi-disciplinary teams of professionals. The creation of budgets and schedules with upset constraints and the identification of risks associated with delays and overruns are also key components to the licencing process.

The evaluation of fill practices within Lafarge's Eastern Canada Region in order to provide a workable solution for both operations and sales and limit the liability to Lafarge – this work was and is being carried out in conjunction with the Tech Services Group.

***Golder Associates Ltd. – Burnaby, British Columbia***

*Hydrogeologist/Geologist, Project Manager & Aggregate Specialist (2002 to 2003)*

Responsibilities included hydrogeological and geological assessments in Canada and internationally as both a Project Hydrogeologist/Geologist, and Project Manager. Additional responsibilities include market development for Golder within the aggregate industry on the West Coast of Canada and the United States. Specific project involvement includes: project manager and co-ordinator for multidisciplinary projects; internal and external presentations; hydrogeological assessments such as water supply, well interference assessments and dewatering issues for mines. Project Management experience in the mining sector includes aggregate quality and resource evaluations and site selection and due diligence studies for the aggregate industry.

***Beck & Associates GeoConsultants Inc. – Vancouver, British Columbia***

*Hydrogeologist/Geologist and Associate (2001 to 2002)*

Project Hydrogeologist/Geologist and Associate with responsibilities that included: project management; presentations; resource and economic evaluations; business development; proposal and report preparation; project cost control and tracking; technical review of reports of multi-disciplinary project teams; involvement in the development of service portfolios and the development and implementation of marketing strategy for local and provincial mining of industrial minerals; and development of site investigation strategies that include both hydrogeological and geological aspects.



***Golder Associates Ltd. – Mississauga, Ontario***

*Hydrogeologist/Geologist and Project Manager (1995 to 2001)*

Responsibilities included hydrogeological and geological assessments in Canada and internationally as both a Project Hydrogeologist/Geologist, and Project Manager. Project involvement included: project manager and co-ordinator for multidisciplinary projects; presentations; resource and economic evaluations; contaminant hydrogeology of waste management facilities and industrial sites; hydrogeology of open pit mines and tailings basins; water supply and dewatering issues for mines; and well interference assessments. Project Management experience in the mining sector included Aggregate Quality and Resource evaluations and Site Selection and Due Diligence studies.

***Dames & Moore, Canada – Cambridge, Ontario***

*Hydrogeologic Assistant (Jan. 1993 to Dec. 1993)*

Involved in remedial investigations and reporting. Responsibilities included the installation of monitoring wells, and frequent development and sampling of wells. In addition, responsibilities included storm water runoff analysis, and pumping test and response test analysis. Further projects included the analysis of cones of depression and influence of municipal wells on remedial site.





## PROJECT EXPERIENCE – SELECTED PIT AND QUARRY RELATED PROJECT MANAGEMENT EXPERIENCE

- Nelson Aggregate Co.**  
Burlington, Ontario,  
Canada  
Project Manager and Senior Hydrogeologist for a licence application of a below water limestone quarry extension in Burlington, Ontario. The study included the evaluation of hydrogeological impacts on neighbouring water wells, and surface water and natural environment features. This study included a multidisciplinary team that assessed the blasting, surface water, geologic and hydrogeologic conditions of the area and the impacts the proposed development would have on neighbouring receptors
- Erie Sand & Gravel**  
Southwest, Ontario,  
Canada  
Project Director and Senior Hydrogeologist for a below water table sand and gravel operation located in south western Ontario. The proposed application was unusual in that the nature of the sand and gravel deposit resulted in dewatering impacts as the resource is being extracted. Impacts from extraction of this deposit were assessed on the surrounding water wells and surface water features.
- Lafarge Canada Inc.**  
Manitoulin, Ontario,  
Canada  
Project Manager and Senior Hydrogeologist for a licence application of a below water limestone quarry extension in Manitoulin, Ontario. The study included the evaluation of hydrogeological impacts on neighbouring surface water and natural environment features. This study included a multidisciplinary team that assessed the blasting, natural environment, geologic and hydrogeologic conditions of the area and the impacts the proposed development would have on neighbouring receptors.
- Confidential Client**  
Erin, Ontario, Canada  
Project Manager and Senior Geologist for an evaluation and development of a mining plan for a sand and gravel pit located in the Township of Erin. The pit had historical geological phasing information available and the purpose of the study was to provide the site manager with a simplistic phasing plan that included the geological information as well.
- Confidential Client**  
Brant, Ontario, Canada  
Project Manager and Senior Hydrogeologist for a licence application of a below water sand and gravel pit located in the Grand River watershed in County of Brant, Ontario. The study included the evaluation of the hydrogeological impacts on surrounding water wells and natural environment features, including a cold water fishery, resulting from the exposure of the water table through the below water extraction of the sand and gravel resource.
- CBM Aggregates**  
Mosport, Ontario,  
Canada  
Project Manager for the evaluation of the variability in deposits in a sand and gravel pit located in the Mosport, Ontario area. The preliminary evaluation was carried out using a combination of geophysical resistivity techniques and test pitting for calibration. The method was found to be successful in mapping out areas of finer grained material that was not economical to extract.



**Bates Barristers**  
Toronto, Ontario,  
Canada

Project Manager and Senior Geologist for the evaluation of remaining resources in a sand and gravel pit located in the Alton, Ontario area. The value of the property was under dispute between two parties who were negotiating the purchase/sale of the land. Golder provided a resource estimate on the property from the results of an extensive drilling and aggregate testing program that was then provided to a valuation company who used the information in conjunction with the determined values for the land and equipment on the site in setting a purchase price for the assets.

**Lafarge Canada Inc.**  
Paris, Ontario, Canada

Project Manager of a multidisciplinary team for a licence application of a below water sand and gravel pit located in the Grand River watershed in Paris, Ontario. The study included the evaluation of the hydrogeological impacts on surrounding water wells and natural environment features resulting from the exposure of the water table through the below water extraction of the sand and gravel resource. Included in the study was the development of an extraction plan for the resource that took into consideration the results of the hydrogeological, natural environment and noise study conclusions and recommendations.

**Lafarge Canada Inc.**  
Dundas, Ontario,  
Canada

Project Manager and Senior Hydrogeologist for a licence application of a below water limestone quarry extension in Dundas, Ontario. The study included the evaluation of hydrogeological impacts on a neighbouring Provincially Significant Wetland feature and surrounding domestic water wells. This study included a multidisciplinary team that assessed the blasting, natural environment, geologic and hydrogeologic conditions of the area and the impacts the proposed development would have on neighbouring receptors.

**Greater Vancouver  
Water District**  
North Vancouver, British  
Columbia, Canada

Project Manager and Geologist for an aggregate resource evaluation of the Km 4 Pit located in the Lower Seymour Conservation Reserve. The aggregate resource evaluation included the development of an extraction plan and product assessment for the property to confirm the presence of the necessary granular material for future construction projects being undertaken by the GVRD within the LSCR

**British Columbia  
Building Corporation**  
Chilliwack, British  
Columbia, Canada

Project Manager and Geologist for an aggregate resource evaluation of the Mount Thurston Correctional Facility located in Chilliwack, BC. This aggregate resource estimate can be used to help BCBC value the property, prior to sale, such that the resulting purchase price reflects not only the surficial real estate value but also the value of the potential underlying aggregate resource.

**British Columbia  
Building Corporation**  
Chilliwack, British  
Columbia, Canada

Project Manager and Geologist for an aggregate resource evaluation of the Centre Creek Correctional Facility located in Chilliwack, BC. This aggregate resource estimate can be used to help BCBC value the property, prior to sale, such that the resulting purchase price reflects not only the surficial real estate value but also the value of the potential underlying aggregate resource.

**Ministry of  
Transportation**  
Sea-To-Sky Highway,  
British Columbia,  
Canada

Aggregate specialist for an aggregate resource potential evaluation of the excavated material from the proposed realignment of the Sea-To-Sky Highway, Horseshoe Bay to Squamish. The aggregate resource potential evaluation included a detailed assessment on the suitability of the various materials expected to be encountered during construction of the alignment and an assessment regarding the potential utilisation of the material once excavated.



**Dufferin Aggregates**  
Cayuga Materials,  
Ontario, Canada

Responsibilities included the Project Management of a due diligence study that was carried out for Dufferin Aggregates for the Cayuga Materials and Construction acquisition. This involved co-ordinating efforts with disciplines such as planning, liability assessment, hydrogeology, geology and contamination assessment for each of the properties owned and operated by Cayuga Materials. Phase I investigations were carried out and recommendations made to Dufferin for dealing with the potential issues found on the properties. In addition, geological definition for the two bedrock properties was carried out, including quality sampling and potential resource calculations.

**Dufferin Aggregates**  
Gormley Aggregates,  
Ontario, Canada

Project Manager for a due diligence study was carried out for Dufferin Aggregates for the Gormley Aggregates acquisition. This included Phase I investigations that were carried out on each of the Gormley Aggregates properties. Phase II work was then carried out based on the recommendations provided in the Golder Phase I report in order to comply with regulations on each of the properties.

**Dufferin Aggregates**  
Brechin, Ontario,  
Canada

Project Manager for a geological interpretation and resource evaluation of the Dufferin Aggregates Carden Quarry located near Brechin, Ontario that involved a borehole drilling program, geophysical logging and aggregate quality testing of the rock core. In addition to the drilling program a resource evaluation was completed for the sight identifying a zone of concrete aggregate quality stone that was previously unknown.

**Dufferin Aggregates**  
Mosport, Ontario,  
Canada

Project Manager for a resource evaluation that was completed for Mosport Pits #1 and #2 located near Mosport, Ontario that involved a borehole drilling program and interpretation of existing documentation. This was then supplemented by a geophysical resistivity profiling and confirmation drilling program that was used to complete resource evaluations for the properties including tonnages of both the usable material and the overlying material for the purpose of developing extraction ratios and ultimately a mining plan.

**Dufferin Aggregates**  
Bethany, Ontario,  
Canada

Project Manager for a resource evaluation that was completed for the Bethany Pit property, which included geophysical resistivity profiling and confirmation drilling for both resource found above and below the water table at the site. Areas of favourable extraction ratios were identified in order to supplement the existing mining plans and provide direction for Dufferin to areas where stripping would be economically favourable.

**Dufferin Aggregates**  
Stouffville, Ontario

Responsibilities included the Project Management of a resource evaluation that was completed for the Dufferin Aggregates Naylor Property located in Stouffville, Ontario, which involved the completion of geophysical resistivity lines and a geological evaluation of the property based on the results of the resistivity survey and the available borehole information. This also included the drilling of confirmation boreholes that were used to correlate the geophysical results and when combined with the information from previously completed boreholes three-dimensional surfaces were created to obtain volumetric and tonnage results.



**Dufferin Aggregates**  
Paris, Ontario, Canada

Project Manager for a resource evaluation that was completed for the Dufferin Aggregates Paris Property that involved the completion of geophysical resistivity test lines and a geological evaluation of the property based on borehole information completed by others for the site. This entailed the creation of three-dimensional surfaces of the resource, based on those boreholes, and the application of appropriate slopes and setbacks in order to obtain a representative resource estimate for the property.

**Dufferin Aggregates**  
Mill Creek, Ontario,  
Canada

Project Manager for a resource evaluation that was completed for the Dufferin Aggregates Mill Creek Property that involved the completion of geophysical resistivity lines across the property, and a geological evaluation of the site based on borehole information completed by others. Three-dimensional surfaces of the resource were created, based on those boreholes, and appropriate slopes and setbacks were applied in order to obtain a representative resource estimate for the property based on current mining plans and activities.

**Lafarge Construction**  
Canada  
Flamborough, Ontario,  
Canada

Project Hydrogeologist then Project Manager for an ongoing monitoring program of groundwater levels, groundwater and surface water quality and quarry pumping volumes, at the Lafarge Dundas Quarry operations in Flamborough, Ontario, as part of the conditions of the Permit to Take Water, including preparation of annual monitoring reports submitted to the Ministry of the Environment.

**Blue Circle Cement**  
Bowmanville, Ontario,  
Canada

Project Hydrogeologist and Project Manager for a resource evaluation that was completed on the Blue Circle Cement Bowmanville Quarry, which included aggregate and whole rock testing of rock core from a borehole completed in the centre of the quarry to determine the quality of the rock beneath the existing quarry floor for future bench development. The project also included the analysis of a related increase in groundwater inflow upon future quarry development.

**Ontario Trap Rock**  
Sault St. Marie, Ontario,  
Canada

Project Hydrogeologist for a hydrogeological study that was completed for Ontario Trap Rock in order to assess future mining activities on their surroundings and limit potential impacts that may result from extraction in certain areas of the property.

**Peel Region Aggregate**  
**Assessment**  
Region of Peel, Ontario,  
Canada

Project Geologist for a constraint mapping exercise that was carried out for the Region of Peel to identify areas of potential aggregate resource within the region. This study was subsequently used to establish Official Plan policy for the Region with regard to housing and other future developments.

**R.W. Tomlinson**  
Ottawa, Ontario, Canada

Project Hydrogeologist for a hydrogeological study that was completed for R.W. Tomlinson in support of an application for a quarry below water. The hydrogeological study included the assessment of potential impacts on the surrounding water wells and natural environment features, such as, wetlands and watercourses.

**Dibblee Paving/Lafarge**  
**Construction**  
Ottawa, Ontario, Canada

Project Hydrogeologist for a hydrogeological study that was completed for Dibblee Paving/Lafarge Construction in support of an application for a Permit to Take Water. The hydrogeological study included the assessment of potential impacts on the surrounding water wells and natural environment features, such as, wetlands and watercourses through the analysis of potential groundwater drawdown effects/impacts on those features.



**Lafarge Construction  
Canada**  
Flamborough, Ontario,  
Canada

Project Hydrogeologist for groundwater inflow estimates for the deepening of the Dundas Quarry to above the Vinemount Member shale. These inflow calculations were part of an overall study used to determine the viability of the quarry deepening with respect to blasting, pop-ups and increased groundwater inflow through the newly exposed Lower Eramosa Member limestone.

## PROJECT EXPERIENCE – SELECTED HYDROGEOLOGICAL (GROUNDWATER) RELATED EXPERIENCE

**Groundwater  
Management Study**  
Stratford, Ontario,  
Canada

Project Hydrogeologist then Project Manager for a groundwater management study that was completed for the City of Stratford Public Utilities Commission (PUC) as part of the Ministry of the Environment Groundwater Protection Plan. The City of Stratford was known to be completely dependent upon groundwater obtained from the bedrock aquifers beneath the City as their source of water. As such, the study was focused on the susceptibility of this aquifer to contamination and therefore included the drilling of a soil-cored borehole through the glacial till materials in order to determine the potential for vertical contamination migration through the soils. The study also involved the examination of long-term water level trends in the City and an analysis of the capacity of the municipal system for sustaining current and future water demands. The ultimate goal of the study was to provide the PUC with a groundwater protection plan that included, among others, amendment recommendations to the City Official Plan to include the protection of groundwater as being a goal for the City. Responsibilities also included the presentation of the study findings and recommendations to the City Council.

**Groundwater  
Management Study**  
County of Victoria,  
Ontario, Canada

Project Hydrogeologist then Project Manager for a groundwater management study that was completed for the County of Victoria (now named the City of Kawartha Lakes) Planning department as part of the Ministry of the Environment Groundwater Protection Plan. The County was found to be underlain by three main aquifers; the Precambrian Shield in the north, the limestone plains in the central portion of the County and the Oak Ridges Moraine in the south. As part of the study a 170 m soil-cored borehole was completed through the Oak Ridges Moraine and 6 monitoring wells were installed in order to assess the groundwater gradients, which then in turn could be used in the future for assessing the impacts of development on recharge to the aquifer. The study included an aquifer vulnerability assessment for the County that included the use of information from approximately 14,000 water well records. This in turn was used to generate a groundwater protection plan for the County that included a recommendation, among others, to develop a groundwater information database for future data management requirements of the County. Responsibilities also included presentations to Steering Committee members and the elected Council of the County.



**Adams Mine Landfill**  
Kirkland Lake, Ontario,  
Canada

Project Hydrogeologist/Geologist for a hydrogeological work program that was carried out at the Adams Mine Landfill site near Kirkland Lake, Ontario over a 9-year period, leading to approval of the facility under the Environmental Assessment (EA) act. Personal involvement in the project occurred over a 5-year period. More recently in 1998/99, responsibilities included sophisticated packer testing using pulse testing technology and the analyses of the testing using advanced response testing software for determining hydraulic conductivity and pressure head results in two 350 m deep angled drillholes beneath the open pit mine. The results from this program were used to satisfy conditions placed on the development of the landfill during an EA hearing. Once the program was completed and the results were reviewed the site was subsequently approved for landfill construction.

**Meridian Gold**  
Atacama Desert, Chile

Project Hydrogeologist for a drilling program that consisted of the construction of two 300 m deep 10" diameter production wells, two 300 m deep 6" diameter monitoring/production wells and seven 70 to 300 m deep 4" monitoring wells that were completed for the purpose of providing a water supply to a proposed Gold mine in the Atacama Desert. Each well was geophysically logged and two pump tests were carried out on the two large diameter wells for a period of 5 days each. 2D Modelling of the wells was completed in order to determine the influence long term pumping from both the 10" and 6" wells at both pumping well locations.

**City of Burlington**  
Burlington, Ontario,  
Canada

Project Hydrogeologist for a drilling and response-testing program that was carried out at the Kernclyffe Park (old Nelson Quarry) property as part of the City of Burlington Master Plan for rehabilitation of the abandoned quarry. The program involved an assessment of the competency of the shale located beneath the old quarry floor in order to determine whether the existing wetland would be sustained or be depleted due to leakage. In addition, water supply for the park was analysed from the well data to determine the feasibility of developing a water supply well from the tight rock formations based on quality and quantity.

**Canada Brick**  
Burlington, Ontario,  
Canada

Project Hydrogeologist/Geologist for a hydrogeological work program that was carried out at the Canada Brick Aldershot Quarry. The work was conducted to obtain the necessary approvals from the Region of Halton and City of Burlington to develop the quarry and construct a new brick plant. The program required assessment of potential impacts from two adjoining landfills during quarry expansion.

**Blue Circle Cement**  
Bowmanville, Ontario,  
Canada

Project Hydrogeologist/Geologist for a hydrogeological program was carried out as part of a resource evaluation and planned deepening of the BCC Bowmanville Quarry. Hydraulic testing was carried out to provide the basis for estimates of groundwater inflow into the quarry under existing conditions and following completion of an additional bench.





**Government of Barbados**  
Mobil Oil Refinery,  
Barbados

Project Hydrogeologist for a tidal monitoring program that was carried out at the Mobil Oil Refinery in Barbados in order to determine the influence to contaminant transport. Two pump tests were carried out on site in order to determine the transmissivity of the soil and coral in relation to the over 40 response tests that were also carried out. The pump test and response test results were then correlated to the monitoring of the tidal information collected in some 24 wells across the site in order to determine the likely migratory pathways of the hydrocarbons located on site.

**Government of Canada**  
Port Hope, Ontario,  
Canada

Project Hydrogeologist for a packer testing program that was carried out for the Sighting Task Force on a borehole that was drilled for the purpose of selecting a Nuclear Repository. This involved very low hydraulic conductivity testing through the entire 210 m section of limestone and shale.

**Canada Gypsum Company**  
Hagersville, Ontario,  
Canada

Project Hydrogeologist for a packer testing program that was carried out on a proposed venting shaft location for the Canada Gypsum Company in order to determine the potential for groundwater inflow during the construction phase of the project.

**Mandarin Golf and Country Club**  
Markham, Ontario,  
Canada

Project Hydrogeologist for a water supply study that was carried out for the Mandarin Golf and Country Club to provide detailed information on water use and potential interference of neighbouring water wells. Mandarin required this study in order to comply with their Permit To Take Water for the future water taking needs of the golf course.

**Dufferin Aggregates**  
Milton, Ontario, Canada

Project Hydrogeologist for the testing of a water supply well that was constructed for the Dufferin Aggregates Milton Quarry maintenance shop in order to replace previously poorly constructed water well. A pump test was carried out on the well to determine the potential yield of the well from the Whirlpool Sandstone Formation and the quality of the water that would be available from that formation.

**TrueNorth Energy Inc.**  
Fort McMurray, Alberta,  
Canada

Project Hydrogeologist for the installation of monitoring wells and an injection well to assess the feasibility of process water disposal in the lower geological sand unit (Basal Water Sands) of the McMurray Formation. Once the installation was completed a step test was carried out at various pumping rates to assess the capability of the unit to receive high volumes of injected water. Pressure responses were recorded within the injection well and the neighbouring monitoring wells, throughout the step test and recovery periods, with the use of automated dataloggers and transducers.

## PROJECT EXPERIENCE – SELECTED GROUNDWATER QUALITY RELATED EXPERIENCE

**St. Lawrence Cement**  
Mississauga, Ontario,  
Canada

Project Hydrogeologist for a groundwater quality study that was carried out on the Cement Kiln Dust piles at the St. Lawrence Cement facility in Mississauga, Ontario. This study was completed in order to establish compliance with regulatory agencies for both air emissions and groundwater discharge off site.





**Kidd Creek Mines**  
Timmins, Ontario,  
Canada

Project Hydrogeologist/Geologist for a groundwater quality study that was carried out on the metallurgical plant site of the Falconbridge Kidd Creek site located near Timmins, Ontario. A series of monitoring wells were installed and sampled in order to profile known contamination on the site. The geological conditions beneath the plant site and tailings basin were also defined in order to profile the most likely pathways of migration for the different sources of contamination.

**Canadian National Railway**  
Vaughn, Ontario,  
Canada

Project Hydrogeologist/Geologist for a study that was initiated on the Canadian National Railway McMillan Yard located in Vaughn, Ontario in order to establish contamination across the site in both the groundwater and soil. This was carried out in order to allow CNR to remediate portions of their site that had not been address within a certain time frame established by CNR.

**Lindsay Landfill**  
Lindsay, Ontario

Project Hydrogeologist/Geologist for a borehole and monitoring well installation program that was carried out at the Lindsay Landfill in order to provide samples in areas where leachate was suspected of migrating. The monitoring wells were then included in the monitoring program for the Lindsay Landfill.

**Brow Landfill**  
Flamborough, Ontario

Project Hydrogeologist for the Redland Quarries (now Lafarge) owned industrial waste landfill on the Niagara Escarpment, which no longer accepts waste and is being rehabilitated. Regulations required that continued monitoring of groundwater levels and sampling of surface and groundwater be carried out at the site in order to maintain compliance. Annual reports are submitted to the Ministry of the Environment summarizing the results and interpreting the required steps for future monitoring.

**Regional Municipality of Waterloo**  
Cambridge, Ontario

Project Hydrogeologist/Geologist for a groundwater quality study that was carried out at the municipal landfill in Cambridge, Ontario, which involved the drilling of additional monitoring wells in key locations to be included in the monitoring program established for the site by the Region.

**TRAINING**

***Artificial Groundwater Recharge***  
2005

***Conflict & Negotiations Course***  
2003

***Project Management Course***  
1999

***Risk Management and Contracts Course***  
1999

***Client Service and Business Development Course***  
1999

***EPA 40-Hour Contaminated Health & Safety Training Course***



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**PROFESSIONAL AFFILIATIONS**

P.Geo., Professional GeoScientist Designation, Association of Professional GeoScientists of Ontario (APGO), 2004