



Education

M.Sc. Applied Earth Sciences - Hydrogeology and Environmental Geochemistry, University of Waterloo, Ontario, 1995

B.Sc. Applied Earth Sciences - Geophysics, University of Waterloo, Ontario, 1992

Golder Associates Ltd.

As a technical specialist and Principal in Golder's Mississauga office Ken works on finding solutions to some of the mining industries most difficult problems. Ken has worked as task lead, project manager, and project director on Environmental Baseline Studies, Environmental Assessments and/or environmental projects related to mining in almost every province and territory in Canada as well as many foreign countries including USA, Australia and other countries in Asia, Europe, Africa and South America. Ken applies his understanding of mining and his 20 years of mining-related environmental experience to help direct the most appropriate data collection and reporting strategies, predict mining related impacts and to develop proper management strategies for mine wastes.

Employment History

Golder Associates Ltd.

Associate then Principal, Hydrogeochemist (2002 to Present)

Recognized company wide technical resource in the field of mining geochemistry and hydrogeology.

Golder Associates Ltd.

Mine Waste and Environment Division Manager (2006 to 2013)

Responsible for providing strategic direction and management of a group of over 50 professionals focused on mine waste science and engineering.

Golder Associates Ltd.

Hydrogeochemist (1995 to Present)

Mine environment and acid mine drainage specialist responsible for management, design, and organization of tailings, waste rock, mine water, mine waste and environmental projects. Projects are generally focused on metal mobility in soils and water, acid mine drainage, geochemistry, hydrogeochemistry, hydrogeology, environmental implications and mitigation options. Current responsibilities include development of recommendations for property management, environmental assessment/feasibility studies, and closure options for mining projects.

More specific job aspects include identifying and characterizing mine waste, conducting estimates of acid generation potential, metal mobility, radionuclide mobility, seepage, potential chemical loading, and receiving water impacts through assessment of hydrogeology, geochemistry, water quality, and hydrology data on a local and/or regional scale. Estimates of water quality implications are based on interpretation of the range of possible input data to develop ranges and/or probabilities associated with discharge chemistry values.



Golder Associates Ltd.

National Leader – Golder Associates Principal and Associate Council - Canada (2013 to present)

Golder Associates Ltd.

Member – Mining Advisory Group –Canada (2010 to 2013)

Helped form and participated in the Canadian Mining Advisory Group (MAG) to provide strategic direction as a company; integrate and take advantage of resources across Canada. Helped define the Mining Business Leader role and provided strategic direction to the Mining Business Leader in his role.

Waterloo Centre for Groundwater Research – Waterloo, Ontario

Research Hydrogeochemist (1995)

Conducted hydrogeologic and geochemical analysis of flow systems; developed proposals for funding; developed and constructed field and laboratory equipment.

University of Waterloo – Waterloo, Ontario

Student Research Assistant (1992 to 1995)

Organized and conducted geochemical sampling programs, supervised borehole drilling and logged split spoon samples, obtained and analysed geophysical data (Shallow seismic, EM, and resistivity) and assisted in installation of reactive barrier used in remediation of nitrate and sulphate plumes. Conducted groundwater flow and geochemical speciation modelling.

Waterloo Centre for Groundwater Research – Waterloo, Ontario

Research Hydrogeochemical Technician (1990 to 1992)

Organized and conducted geochemical sampling programs; conducted laboratory analysis for total sulphur, iron, and carbonate content; designed, developed and constructed laboratory and field sampling and testing equipment; installed drivepoint, and bundle type piezometers; obtained and logged cores through drilling and continuous coring techniques; assisted driller in hollow stem auger borehole drilling and well installation; conducted laboratory column experiments and assisted in septic system studies.

Atomic Energy of Canada Limited – Pinawa, Manitoba

Hydrogeochemical Technician (1989)

Sampled and analysed groundwater to trace flow patterns; serviced diesel engines and assisted with fracture mapping by helium injection.

Minnova Inc. – Thunder Bay, Ontario

Geophysics and Geology Assistant (1989)



PROJECT EXPERIENCE – ENVIRONMENTAL ASSESSMENT

De Beers Canada - (2003 – present)
Northwest Territories
Senior Geochemist responsible for conducting, organizing, and/or reviewing annual ARD/ML inspections and preparation and review of annual reports regarding AARD/ML required under the water licence.

De Beers Canada - Gaucho Kué (2009 - Present)
Northwest Territories
Senior Geochemist, responsible for overall supervision and integration between information collected prior to 2008 and the additional geochemical baseline assessment components. This included supplemental characterization of processed kimberlite, mine rock, ore pads and construction material for acid generation potential, long and short term leachate potential, and source term water quality from these material through static and kinetic testing. Also included were preparation of geochemistry baseline reports and preparation of information related to the environmental impact statement.

Fortune Minerals - DAR (2009 - present)
Northwest Territories
Senior Geochemist, responsible for review of geochemical testing and water quality estimates in support of DAR and feasibility evaluation. Includes geochemical assessment of waste rock, tailings, plant materials, prediction of mine water quality, prediction of site discharge water quality, and prediction of downstream water quality.

Fortune Minerals Engineering and DAR Baseline (2005 - present)
Northwest Territories
Project Director for engineering trade off studies responsible for integrating engineering and ESIA components of the project to enhance value to the project while protecting key environmental aspects of the site. Senior Geochemist, responsible senior review of geochemical testing and water quality baseline data collection in support of DAR.

Osisko – Hammond Reef (2010 - Present)
Northwestern Ontario
Project Director responsible for overall project implementation and quality. Task lead responsible for senior review of geochemical testing and water quality estimates in support of EIS, pre-feasibility and feasibility evaluation. Includes geochemical assessment of waste rock, tailings, plant materials, prediction of mine water quality, prediction of mine water quality, prediction of site water quality.

Kinross – Dvoinoye Mine (2010 - 2011)
Far East Russia
Senior geochemist and water quality specialist responsible for supervision of geochemical and water quality assessment of a proposed gold mine expansion in Chukotka Autonomous Okrug in Far Eastern Russia. Project involves assessment of geochemical loading and potential acid generation from all sources of mine waste and mining on site for an EIA document to international standards.

Dornod Uranium Project EIS (2007 - 2009)
Mongolia
Project Director responsible for overall project implementation and quality. Task lead responsible for senior review of geochemical testing and water quality estimates in support of EIS, pre-feasibility and feasibility evaluation to IFC standards. Includes geochemical assessment of waste rock, tailings, plant materials, prediction of mine water quality, prediction of mine water quality, prediction of site water quality.



**Xstrata - Kabanga
Nickel - Geochemistry
Baseline Assessment
and Impact
Assessment (2007 -
2013)
Tanzania**

As the Division Manager, responsible for selection of appropriate management structure and personnel on the project, and responsible for providing key staff resources to the project. Also Senior Discipline Lead for Geochemistry and Water Quality on the project. Responsible for management for geochemical and water quality assessment of this proposed Nickel mine in Tanzania, Africa. Project involves all aspects of an environmental impact statement, including physical, biological and social. Integration with engineering services is also a key driver for the success of this project.

**De Beers Canada
Mining (formerly
Winspear Diamonds
Ltd.) - (1999 – 2002)
Northwest Territories**

Project Geochemist responsible for development and implementation of a large geochemical baseline assessment program, mine water quality assessment, and site water quality assessment for environmental assessment and permitting of DeBeers Canada Mining, Snap Lake diamond Project in Northwest Territories.

Provided expert witness testimony on geochemistry, mine water quality, and site water quality aspects of the project at the MVEIRB public hearings. Provided and presented technical information in public information sessions and responded to inquiries and information requests related to geochemistry, mine water quality, and site water quality modelling aspects of the project.

The geochemical baseline assessment components of this project include: Characterization of processed kimberlite, mine rock, ore pads and construction material for acid generation potential, long and short term leachate potential, and source term water quality from these material through static and kinetic testing; Evaluation of on-site conditions during pre-mining and the advanced exploration project; and preparation of geochemistry baseline reports relating to land use permits, water license permits, scoping documents, feasibility documents, and the environmental impact statement.

The site water quality assessment involved integrating aspects of the proposed mine development with the baseline geological and water quality data as provided by the project hydrogeologists to develop estimates of potential water quality during operations and closure.

**Diavik Diamond Mines
(2006-2009)
Northwest Territories**

Senior Geochemist, responsible for development of geochemical testing and water quality estimates in support of feasibility evaluation of A419 pit. Includes geochemical assessment of A419 waste rock and paste backfill materials.

**Diavik Diamond Mines
(2005)
Northwest Territories**

Completed review of site geochemistry and mine water quality data for comparison to EA prediction values.

**Touquoy Project (2006)
Nova Scotia**

Senior Geochemist responsible for development of geochemical testing and water quality estimates in support of feasibility evaluation. Includes geochemical assessment of waste rock, tailings, plant materials, prediction of underground mine water quality predictions, prediction of site discharge water quality, and prediction of downstream water quality.



**De Beers Canada -
Gaucho Kué (2002)**
Northwest Territories

Conducted a gap analysis of geochemical and site water quality issues. This included reviewing and evaluating all available data in order to provide estimates of potential work requirements and costs associated with these aspects of the project. A cursory review of core samples and some supplementary, preliminary sampling to assess potential ARD issues related to the project was also conducted.

**Taseevskoye Project
(2007-2009)**
Balay, Russia

Senior geochemist and water quality specialist responsible for geochemical and water quality assessment of a proposed gold mine in Balay, Russia. Project involves assessment of geochemical loading and potential acid generation from all sources of mine waste and mining on site and implementation of EIA document.

**Xioncun Project (2006-
2008)**
Tibet, China

Senior Geochemist responsible for senior review of geochemical testing and water quality estimates in support of IS and feasibility evaluation. Includes geochemical assessment of waste rock, tailings, plant material, prediction of underground mine water quality predictions, prediction of site discharge water quality, and prediction of downstream water quality.

**Voisey's Bay Nickel -
Argentia Site (2003)**
Newfoundland

Providing senior geochemical review and guidance on testing for evaluation of leach residues and selection of appropriate disposal strategies.

**Cumberland
Resources -
Meadowbank Project**
Northwest Territories

Provide senior review of site water quality modelling and estimates.

**Barrick Gold - Buzwagi
Project (2004 - 2009)**
Tanzania, Africa

Senior geochemist and water quality specialist responsible for geochemical and water quality assessment of a proposed gold mine in Tanzania, Africa. Project involves assessment of geochemical loading and potential acid generation from all sources of mine waste and mining on site and implementation of EIA document.

**Tiberon Mineral
Resources (2003 –
2007)**
Viet-Nam

Project Manager for geochemical and water quality assessment of a proposed bismuth-tungsten mine site in Viet-Nam. Project involves assessment of geochemical loading and potential acid generation from all sources of mine waste and mining on site. All aspects of the proposed mine development were integrated with the baseline geological and water quality data to develop estimates of potential water quality during operations. Also responsible for management of project components related to risk assessment for worker health. Mitigation plans, safe work practices, and disposal options were developed for parameters of concern. Results were included in the environmental site assessment documents and bankable feasibility documents submitted to the regulating authorities.

**Aquiline Resources -
Calcatreu Project (2004
– 2007)**
Argentina

Senior geochemist and water quality specialist for geochemical and water quality assessment of a proposed mine in southern Argentina. Project involves assessment of geochemical loading and potential acid generation from all sources of mine waste and mining on site.



**PanAmerican Silver -
Manantial Espejo
Project (2003 – 2006)**
Argentina

Senior geochemist and water quality specialist for geochemical and water quality assessment of a proposed mine in Southern Argentina. Project involves assessment of geochemical loading and potential acid generation from all sources of mine waste and mining on site.

**Barrick Gold -
Tulawaka Gold Mine
(2002-2003)**
Tanzania

Project discipline leader/manager for geochemical and water quality assessment of a proposed gold mine in Tanzania, Africa. Project involves assessment of geochemical loading and potential acid generation from all sources of mine waste and mining on site. The geochemical baseline assessment components of this project included: Characterization of all aspects of the site including tailings, waste rock, ore pads and construction material for acid generation potential; Determining long and short term leachate potential, and source term water quality from each of these material through static and kinetic testing; Preparation of geochemistry baseline reports relating to land use permits, water license permits, scoping documents, and the environmental impact statement. The site water quality assessment involved integrating all aspects of the proposed mine development with the baseline geological and water quality data to develop estimates of potential water quality during operations and closure. The results of the water quality model were assessed and reasonable geochemical controls on solute migration were developed where applicable.

Treatment alternatives were evaluated and a site water management plan was developed to meet environmental and project objectives while minimizing project costs.

**Antamina Compañía
Minera (2000)**
Antamina, Peru

Reviewed sample suitability and organized initial test program for samples. Reviewed mass loading model for tailings impoundment for proposed copper mine.

**Boliden Apirsa S.A. -
Los Frailes Mine (1998-
1999)**
Azna collar, Spain

Immediately following the failure of the Boliden Apirsa Tailings facility in Azna collar, Spain, Golder Associates was hired to help prepare a strategy and necessary information for re-opening the mine. Personal responsibilities on this project included: Co-ordinating analytical test-work on spilled tailings and soil samples; Collections of porewater samples, tailings solids, and mill tailings samples from the tailings remaining in the basin; Collection of waste rock, seepage and pit water samples from around the site; and Geochemical assessment of the remainder of the impounded tailings and waste rock on site.

**Falconbridge Limited -
Raglan Mine (1999)**
Ungava Peninsula,
Northern Quebec

Reviewed acid generation characteristics, water quality and loadings from an ore pad to identify potential implications on treatment requirements and milling operations upon expansion of the pad. Considerations included: permafrost, hydrology, and the temperature of mined ore relative to ambient air.

**Norox Operating
Company Ltd. - Jeroy
Gold Mine (1998)**
Kyrgyzstan

Conducted geochemical evaluation which involved the initial feasibility study of a proposed combined open pit/underground gold mine using a cyanidation circuit. Responsible for geochemical assessment component of the Environmental Impact Statement (EIS) which could be used by international lending institutions to support project financing. Assessment of available ARD data was completed along with an evaluation of environmental issues related to cyanide. Water quality and siting issues were investigated, with consideration given to discontinuous permafrost at higher elevations.



Inco Ltd. - Voisey's Bay Nickel Mine (1998)
Newfoundland

Conducted an internal review of baseline groundwater quality and groundwater surface water data as part of the Environmental Assessment documentation for the Inco Ltd. Voisey's Bay mine site in Labrador. Provided supporting documentation related to possible operating conditions in the tailings basin.

Asacha Gold Mine (1997)
Kamchatka, Russia

Reviewed hydrogeology and water quality of the proposed Asacha Gold Mine in northeastern Russia. The assessment focused upon chemical water quality and stream-flow impacts associated de-watering of an underground mine and construction of a tailings basin. The results of the assessment formed part of the mine feasibility study.

Kvaerner Davy, TVX Gold Ltd. (1996)
Kasperske Hory, Czech Republic

Responsible for prediction of chemical loading to the receiving water for a pre-feasibility study. Several aspects of the project were coordinated and assessed in order to predict potential water quality, including: Nitrate loading to the mine water and mine water characterization; Process water characterization; Expected tailings chemistry and acid generation characteristics; Hydrology of the tailings basin and surrounding area; Background water quality assessment; Development of preliminary treatment system options and costs; Effluent water characteristics were predicted relative to applicable local and regional effluent standards to develop and recommend tailings deposition plans and treatment options.

Teck Corporation - Pogo Project - Geochemical Review and Support
Alaska

Provided internal review and evaluation of bedrock and overburden groundwater chemistry and how it relates hydrogeological conditions at the Teck Corporation Pogo project in Alaska. Additional work involved presentation of available water quality data. Considerations at this site included permafrost.

PROJECT EXPERIENCE – MINE CLOSURE AND REHABILITATION

Saskatchewan Research Council - Lorado Mine (2010 – Present)
Northern Saskatchewan

Senior Geochemist responsible for geochemistry, water quality, and evaluation of potential remediation options. Work completed as part of an option evaluation study which integrates engineering and scientific understanding of the site to select appropriate final closure measures.

AANDC - Colomac Mine (2010 – 2011)
Northwest Territories

Senior geochemist responsible for evaluation and identification of potential mechanisms that could lead to release of gas from an abandoned, flooded tailings impoundment. Considerations included: gas composition evaluation, biogeochemical processes, physical release mechanisms and influence of gas release on ice strength over vent zones. Results used in the determination of influencing factors that could lead to safety considerations for work on ice over flooded tailings.

Freeport McMoRan – Cerro Verde Mine (2010)
Peru

Senior geochemist responsible for design and supervision of test program to characterize waste materials for a large copper mine in the Andes. Reviewed sample suitability, organized and conducted initial test program for samples. Contributed to design of on-site test programs.



**Cerrejon Coal Mine
(2010 - 2011)**
Colombia

Senior geochemist responsible for evaluation and identification of potential mechanisms that could lead to water quality degradation. Perform a high level diagnosis of the potential problem of impact on the waters of the quaternary aquifers and the surface water courses due to Cerrejón’s mining operations, and propose necessary measures for the prevention, control, and mitigation of the impact.

**EWL Ltd. - Gordon
Lake - Geochemical
Evaluation for Closure
Options (2008 -
present)**
Northern Ontario

Project Director responsible for design and implementation of biological, hydrological, hydrogeology, engineering and risk assessment programs to appropriately evaluate the Gordon Lake tailings. Responsible for integrating all aspects of the site characterization studies with engineering controls to provide the most effective long term remediation strategy and final closure measures to be implemented at the site.

**EWL Ltd. – Greyhawk
Mine (2010 - present)**
Northern Ontario

Project director responsible for supervision and strategic direction of a geochemical evaluation program to evaluate uranium and radionuclide mobility and evaluate source controls and mitigation measures necessary.

**EWL Ltd. - Madawaska
Mine (2005 - present)**
Northern Ontario

Senior Geochemist responsible for design and implementation of a geochemical evaluation program to evaluate uranium and radionuclide mobility and evaluate source controls and mitigation measures necessary.

**EWL Ltd. - Dyno Mine -
(2005 - present)**
Northern Ontario

Senior Geochemist responsible for design and implementation of a geochemical evaluation program to characterize and evaluate uranium tailings distribution downstream of a deposition source.

**Encana Ltd. - Lorado
Mine - Geochemical
Evaluation for Closure
Options**
Northern Saskatchewan

Senior Geochemist responsible for design and implementation of a geochemical evaluation program for the abandoned Lorado Mine uranium tailings. Responsible for site water quality modelling and evaluation including development of source term values, pathway interactions, and receiver loading estimates. Responsible for providing input and recommendations regarding remediation options, risk assessment evaluation, and possible final closure measures to be implemented at the site.

**Cameco Corporation -
Geochemical
Evaluation and
Modelling (2004 - 2007)**
Northern Saskatchewan

Responsible for design and evaluation of ARD program for one of the Cameco waste rock dumps at their Key Lake site and for providing recommendation as to potential waste rock use and disposal options.

**Cameco Corporation -
Geochemical
Evaluation and
Modelling (2003-2004)**
Northern Saskatchewan

Senior Geochemist responsible for geochemical modelling and evaluation of a plume and acidic mine water. Used PHREEQC and hydrogeologic software to determine potential migration characteristics and remedial measures for uranium and metals in groundwater.

**Inco Limited - Crean
Hill Mine - Mine
Closure, Monitoring
Requirements (2002)**
Northern Ontario

Assessed potential water quality and long term monitoring requirements for closure. Reviewed existing site development, monitoring program, and water quality data. Developed monitoring program for closure.



**Inco Limited -
Lockerby Mine - Mine
Closure, Monitoring
Requirements (2002)**
Northern Ontario

Assessed potential water quality and long term monitoring requirements for closure. Reviewed existing site development, monitoring program, and water quality data. Developed monitoring program for closure.

**Inco Limited -
Shebandowan Mine -
Mine Rehabilitation
Assessment, and
Prediction of Water
Quality (1999-2000)**
Northwestern Ontario

Project Geochemist responsible for supervision of rehabilitation measures and characterization of mine waste, during mine rehabilitation and closure. Water quality and long term treatment requirements during closure/decommissioning were completed. The project also included review of available geochemical data and modelling to ensure QA/QC and proper development of mitigation strategies to best achieve regulatory compliance.

Aspects included: Ensuring proper environmental decommissioning procedures/protocols were followed; Modelling - coupled PHREEQC-V2 and GoldSim; Monitoring program development; and Assessment of treatment requirements.

The affects of seasonal temperatures fluctuation and freezing were accounted for in estimating potential treatment requirements and lime demand.

**Caribou Mines -
Anaconda Tailings -
Chemical Stability at
Closures (2000)**
New Brunswick, Canada

Supervised development of a program to assess potential impacts and closure options of two tailings ponds. Closure options investigated include in-pit disposal, capping, and underwater disposal in an alternate tailings impoundment.

**Falconbridge Limited -
Smelter Complex -
Preparation of Closure
Plan and Options
(1996-1999)**
Falconbridge, Ontario

Lead geochemist responsible for identification and characterization of all potential sources of mine waste and chemical loadings at the Falconbridge Smelter complex near Sudbury, Ontario. This site includes: two mines, seven historic tailings areas, large slag deposits, extensive water management facilities, and the smelter complex itself. Aspects of this large, two-year project included: Assessment of Acid Mine Drainage; Assessment of potential loading from Slag and Mine waste on site; Mine Water Quality Assessment; Surface Water Quality Assessment, Groundwater Quality Assessment; Estimates of site loading and water quality predictions over time; Recommendation of mitigation and treatment strategies to ensure compliance with site discharge limits; and, writing and reviewing smelter site closure plan.

**Sudbury Contact
Mines Ltd. - Victoria
Creek Project -
Geochemical
Assessment, Closure
Planning, Treatment
Requirements (1999)**
Kirkland Lake, Ontario

Factors affecting acid generation from the Waste Rock Piles were assessed, and the lime demand required to neutralize potential acid production was predicted. Potential alternative options with respect to disposal and/or treatment of potentially acid generating (PAG) waste rock assessed.

**Barrick Gold Corp. -
Potential Acquisition -
Investigation of
Closure Scenarios
(1999)**
Brazil

Conducted an assessment of orebody geochemistry, possible closure options and possible water quality. Based on the water quality estimates and closure scenarios, a range of possible treatment costs were provided.



**Rio Algom - Lacnor,
Nordic and Pronto
Mines - Mine Closure
Planning (1995-1997)**
Elliot Lake, Ontario

Responsible for internal review and co-ordination of geochemical and water quality assessment within the project team. Aspects included a hydrogeological investigation of the effectiveness of the perimeter seepage interception ditch around Rio Algom's Nordic Mine Tailings impoundment. The seepage collection ditch was designed to re-direct tailings impacted groundwater seepage to the water treatment plant. Also responsible for co-ordinating and writing sections of the overall closure documents for these idle tailings sites.

**Barrick Gold Corp. -
East Malartic/Barnat
Sladen Tailings - ARD
and Water Quality
Assessment to
Evaluate Closure
(1997)**
Northern Quebec

Assessment of acid generation potential and contaminant loading was conducted at Barrick Minerals East Malartic Tailings. The work included assessment acid: base accounting, mineralogical evaluation and elemental characterization of the tailings solids. This data was assessed in conjunction with unsaturated zone porewater and piezometer water quality data to develop potential acid generation characteristics and potential water quality loading estimates for the tailings. The assessment was used to evaluate closure options for the facility.

**Inco Limited - Victoria
Mine - Geochemical
Assessment for
Closure (1997)**
Sudbury, Ontario

Conducted geochemical assessment of waste rock, and mine site to evaluate closure options and develop a closure plan.

**Falconbridge Limited -
New Tailings Area -
Preparation of Closure
Plan and Options
(1996-1997)**
Falconbridge, Ontario

Preparation of a closure plan for Falconbridge Limited's New Tailings Area near the Falconbridge, Ontario Smelter. This included geochemical characterization on tailings and prediction of impacts of flooding on the quality of surface water and groundwater.

**Falconbridge Limited -
Fecunis Tailings Area -
Assessment of Closure
Options (1995-1996)**
Northern Ontario

Study of options for closure of Falconbridge Limited's Fecunis Tailings Area, considering the feasibility of flooding, slimes cover, removal of tailings and perpetual treatment. Responsible for hydrogeological modelling, co-ordination of geochemical program, reporting, and assessment of chemical loadings. The geotechnical/geochemical investigation lead to a detailed assessment of capital and operating costs for the various options.

**Falconbridge Limited -
Fault Lake Tailings
Area - Review of
Closure Plan and
Options**
Falconbridge, Ontario

Review of geochemical aspects pertaining to a closure plan for Falconbridge Limited's Fault Lake Tailings Area. Closure measures include the construction of a multi-element soil cover to reduce the rate of oxidation of existing sulphidic tailings and to mitigate impacts on regional groundwater.

PROJECT EXPERIENCE – SITE EVALUATION / TREATMENT OPTION EVALUATION

**Hudbay Minerals -
Lalor Project (2011)**
Northern Manitoba

Supervise geochemical characterization of waste rock related to site construction activities.



- Suncor (2011)**
Alberta
Supervise and conduct geochemical modelling to evaluate aquifer compatibility and well fouling potential for aquifer storage and recovery project.
- Confidential Client (2011)**
Canada
Provided senior external advice regarding technical evaluation of economic recovery of uranium from waters.
- Red Chris Mine (2010)**
Northwestern BC
Provided senior external advice regarding appropriateness of key inputs to the the water quality model in the context of the water balance to identify the key sources of mass loading during the mining, closure and post closure periods.
- Goldcorp - Wilanor Mine (2003)**
Red Lake, Ontario
Provided internal review and advice related to arsenic issues associated with GoldCorp's Wilanor Mine property.
- Ovacik Mine - Assessment of HCN Evolution (2002)**
UK
Assessed the potential for hydrogen cyanide gas evolution from a mine treatment/tailings pond.
- Inco Limited - Crean Hill Mine - Treatment Requirements (2001)**
Northern Ontario
Supervised evaluation of potential treatment requirements/refinements to reduce potential lime demand. This resulted in more efficient treatment system, reduction in concentration peaks, and a reduction in lime demand and treatment costs.
- Tara Mines - Assessment of Geochemical Factors Affecting Dam Stability (1997-1998)**
Ireland
Assessed possible geochemical factors that could affect dam stability for a proposed design for a dam raise. The major concern was the potential for filter clogging based on precipitation resulting from discharge of water. PHREEQC modelling was completed to estimate maximum mineral precipitation in the filter zone. These results were used to evaluate the effectiveness of the proposed design.
- Inco Limited - Levack Mine - Evaluation of Source Term Chemistry (1998)**
Northern Ontario
Evaluated observed changes in site runoff inconsistent with those predicted from in the existing closure plan. Evaluation program included geochemical and hydrogeological evaluation of the site, mineralogical assessment of material on site, and site hydrologic assessment. The results of the program revealed that the likely cause of the observed discrepancies was coating of available neutralising minerals with iron hydroxide formed as a result of mineral oxidation.
- Falconbridge Ltd. - Falconbridge and East Mine - Mine Water Characterization and Assessment of Treatment Options (1997)**
Falconbridge, Ontario
Mine water seepage was assessed for metal loading potential, and the existing treatment system was re-evaluated. The analysis suggested current treatment practices were inefficient and costly. As a result an alternative treatment was suggested and implemented successfully.
The project involved: Initial characterization of mine discharge water; MINTQA2 geochemical speciation modelling; Assessment of current treatment practices and recommendations of alternatives (active treatment vs. degassing pond); Follow-up characterization to ensure alternative treatment practices were successful.
Effluent mine water characteristics and potential loading to the environment were also assessed as part of the much larger Falconbridge Smelter closure plan work.



**Les Mines Inmet -
Norbec Tailings (1997)**
Quebec

Initiated and supervised initial stages of evaluation of various cover design options on tailings water quality. Diffusion through the cover layer was assessed for a variety of cover designs using the HELP model to determine rates of diffusive oxygen transport. An oxygen diffusion coefficient was then input into an oxidation simulation program (PYROX) to determine a source loading for seepage and transport modelling. Simulations were optimized for the best possible cover design. The cover has been constructed and follow-up evaluation shows reduction in oxidation rates similar to those projected.

**MEND, Inco Limited -
Whistle Mine - Detailed
Waste Rock
Characterization Study
and Evaluation (1995-
1996)**
Northern Ontario

Lead geochemist responsible for development and implementation of new and existing technologies and protocols to characterize and monitor the geochemical characteristics of the waste rock pile. Aspects of this project included: Developing drilling and sampling methods suitable for use in granitic boulder laden waste rock; Field instrumentation and monitoring of the waste rock for temperature, oxygen concentration and carbon dioxide concentration at multiple depth intervals; Detailed assessment of acid generating characteristics, and determination of the chemical mass loadings originating from the waste rock pile; Piezometers installed in the base of the waste rock and at the foot of the pile were assessed to identify potential seepage pathways; Installation of large scale lysimeters in the waste rock to determine recharge characteristics; Geochemical speciation modelling (MINTEQA2) to determine potential buffering minerals and secondary mineral species that may affect the overall discharge water quality; Preparation of a report suitable for publication as a MEND document. The study is available as a Mine Environment Neutral Drainage (MEND) report through Energy Mines and Resources Canada.

**Inco, Falconbridge -
Hardy and McReady
West Mines -
Evaluation of Non-
Point Source Loading
to Receiver (1996)**
Northern Ontario

Conducted a geochemical assessment of define potential sources of "non-point source" metal contamination reporting to the Onaping River. An evaluation of groundwater associated with the Hardy and McReady West Mines, and associated mine waste deposit was completed. The project involved installation, interpretation of stratigraphy, hydrostratigraphy, groundwater flow patterns and potential sources of contamination.

**Agnico Eagle Ltd. -
Joutel Tailings -
Hydrogeologic and
Geochemical
Assessment (1996)**
Quebec

Conducted a detailed assessment to determine the extent of existing acidic conditions in the tailings and the possibility of ongoing acid generation. The assessment included on-site measurement of sensitive geochemical parameters, collection of continuous samples through the tailings, assessment of porewater chemistry in the saturated and unsaturated zones, and hydrogeologic assessment.

**Cameco Corporation -
Rabbit Lake Tailings -
Geotechnical Review
(1996)**
Northern Saskatchewan

Completed an internal review of geochemical issues affecting groundwater flow and transport modelling that was conducted to assess the Rabbit Lake In-Pit Tailings Management Facility.



**Confidential -
Geochemical
Assessment, Crisis
Response (2001)**
Canada

Assisted with hydrogeological and geochemical assessment of possible causes related to a dam failure and release of acid mine drainage to the environment. Historical and recent hydrologic, water quality, and hydrogeologic records were reviewed and additional on-site information was gathered to develop a range of scenarios that may have lead to the observed failure. Based on the assessment measures provided input to help engineer systems to eliminate future uncontrolled releases. Since implementation of recommendations no further uncontrolled releases have occurred.

**Confidential -
Geochemical Advice,
Crisis Response
(2004)**
Canada

Provided advice on possible implications of acid spill and interactions with aquifer material in relation to observed water quality at downstream production wells.

**Cameco Corporation -
Groundwater
Monitoring Plan
Review (2000-2010)**
Port Hope, Ontario

Reviewed water quality issues associated with Cameco's annual groundwater monitoring review program at its upgrading facility in Port Hope. The review includes the estimation of groundwater flow directions and mass loadings beneath the facility.

**Rio Algom - Stanleigh
Mine - Hydrogeologic
Assessment (1996)**
Elliot Lake, Ontario

Responsible for development of 2-D groundwater flow modelling (SEEP/W) to evaluate seepage through the various cross sections of the facility. The work completed was used to support additional 3-D modelling efforts used in the mine closure development process to estimate seepage rates in the project area. The results were presented to the Atomic Energy Board of Canada and accepted as part of the property closure plan.

**Omai Gold Mine -
Hydrogeological
Assessment and Mass
Loading, Crisis
Response (1995)**
Guyana

Completed 2-D seepage model (SEEP/W) to assist in completion of a detailed water balance for the new No. 2 Tailings Pond, following the failure of their tailings facility. Estimated potential mass loading to the river were developed based on the seepage estimate.

**Aquarius Mine - Pump
Test (1995)**
Timmins, Ontario

Assisted with a pump test to define potential de-watering requirements in a deep alluvial aquifer.

**Jannock Properties -
Pump Test and Water
Quality Evaluation**
Mississauga, Ontario

Organized and conducted a pump test and water quality testing on a former quarry filled with fly ash from thermal power generation to determine possible implications with respect to nearby site development.



PROJECT EXPERIENCE – OTHER WORK EXPERIENCE PRIOR TO GOLDER ASSOCIATES LTD.

- Inco Limited** Copper Cliff Tailings - Geochemical sampling, instrumentation and assessment of the "P" Area Tailings and Seepage.
- Falconbridge Limited** Geochemical sampling and instrumentation for assessment of the geochemistry and hydrogeology of the East Mine Tailings and the Nickel Rim Tailings; and Geochemical sampling and instrumentation for assessment of the Kidd Creek Tailings.
- Agnico Eagle** Geotechnical sampling and instrumentation for assessment of the Joutel Mine Tailings

PROFESSIONAL AFFILIATIONS

- Member, The Association of Professional Engineers, Geologists, and Geophysicists of the Northwest Territories
- Member, The Association of Professional Engineers, Geologists, and Geophysicists of Alberta
- Member, The Association of Professional Geoscientists of Ontario
- Member, International Association of Geochemistry

PUBLICATIONS

Gunsinger, M.R., Boonstra, G.R., Laporte, D.F., and DeVos, K.J. (2012). A multidisciplinary approach to delineate sources of uranium in groundwater. 39th International Association of Hydrogeologists Congress, September 16–21, 2012.

Salzsauler, K., K.J. DeVos, and R. Schryer. 2012. Use of Exploration, Laboratory and Site-Specific Data for the Purpose of Mine Rock Classification, NICO Gold-Cobalt-Bismuth-Copper Project, Northwest Territories, Canada. Proceedings, 9th International Conference on Acid Rock Drainage, May 20-26 2012. Ottawa, Ontario

Gunsinger M.R., G.R. Boonstra, D.F. Laporte and K.J. DeVos. 2012. Integration of hydrogeological, geophysical and geochemical methods for the delineation of natural sources of uranium in bedrock groundwater. Proceedings, 9th International Conference on Acid Rock Drainage, May 20-26 2012. Ottawa, Ontario

DeVos, Ken. Good science - a vital tool in meeting stakeholder concerns. *CIM Magazine*, Vol. 4 - No. 1 (2009)

DeVos, Ken and Greg Warren. The Need for a Balanced Approach to Exploration. *The Northern Miner*, March (2006), 3-9.



DeVos, Ken and Rens Verburg. 2006. *Cemented Paste Backfill Leachate Characteristics: Snap Lake Diamond Mine*. 7th International Conference on Acid Rock Drainage, March 26-29. St. Louis, Missouri.

DeVos, Ken and Che McRae. 2006. *ARD Geochemistry in the Developing World: Dealing with Uncertainty, Regulations, and the need for Characterization of Mine Waste*. 7th International Conference on Acid Rock Drainage, March 26-29. St. Louis, Missouri.

DeVos, K.J., D.F. Haley, R.B. Verburg and R. Johnstone. 2003. *Evaluation of Complex Systems to develop Key Water Quality Influences at the DeBeers Snap Lake Diamond Project*. 6th International Conference on Acid Rock Drainage, July 14-17. Cairns, Queensland, Australia.

DeVos, K.J., F. Barone and D.G. Brown. 2000. *Management of Water Quality in Flooded Tailings Impoundment*. 5th International Conference on Acid Rock Drainage, May 21-24. Denver, Colorado.

DeVos, K.J., P. Pehme and J.P. Greenhouse. 1997. *Ground Geophysical Surveys for Mine Wastes*. Exploration '97 Fourth Decennial Conference on Mineral Exploration, September 14 - 18. Toronto, Canada.

DeVos, K.J., Ritchie, D.G., and Bocking, K.A., 1999. Practical Considerations for Covering Sulphidic Tailings Deposits situated above the Groundwater Table. Proceedings Sudbury '99 Mining and the Environment. Sudbury Ontario. Vol. 1, pp. 291-300.

DeVos, K.J., Bocking, K.A., and MacNamara, B., 1999. The Effect of Changes in Metallurgical Practices on Groundwater Quality at Falconbridge Limited's Smelter Site. Proceedings Sudbury '99 Mining and the Environment. Sudbury, Ontario. Vol. 2, pp. 635-644.

Brown, D.G., DeVos, K.J., Hall, G. and MacNamara, B. 1999. Characterization of slag produced at the Falconbridge Limited Smelter Site. Proceedings Sudbury '99 Mining and the Environment, Sudbury, Ontario Vol.2, pp. 755-764.

Bocking, K.A., DeVos, K.J., Mikkila, B.J., and Hall, G.J. 1999. Closure Planning for the Falconbridge Limited Smelter Complex, Sudbury, Ontario - Issues and Experience. Proceedings Sudbury '99 Mining and the Environment, Sudbury, Ontario. Vol. 3, pp. 873-882.

DeVos, K.J. Petit, C., Martin, J., Knapp, R.A., and Jansens, K.J. 1997. Whistle Mine Waste Rock Study. Mine Environment Neutral Drainage (MEND) Report, Energy Mines and Resources Canada.

DeVos, K.J., Whistle Mine Waste Rock Monitoring, 1996. Presentation for: Prediction of Acid Rock Drainage, Environment Canada (MEND) Workshop. Simon Fraser University, Harbour Centre Campus, November 7-8, 1996.



DeVos, K.J. 1995. Geochemistry and Hydrogeology of a Plume of Tailings Derived Water, Copper Cliff, Ontario. M.Sc. Thesis, University of Waterloo.

DeVos, K.J., Blowes, D.W., Robertson, W.D., and Greenhouse, J.P. 1995. Delineation and Evaluation of a Plume of Tailings Derived Water, Copper Cliff, Ontario. Proceedings Sudbury '95 Mining and the Environment Sudbury, Ontario, May 28 - June 1, 1995.

DeVos, K.J., Blowes, D.W., Robertson, W.D., and Greenhouse, J.P. 1994. Delineation and Evaluation of a Plume of Tailings Derived Water, Copper Cliff, Ontario. Poster paper in: Proceedings of the Geological Association of Canada, Mineralogical Association of Canada, Waterloo, Ontario.

**Education**

*Ph.D. (p/t, suspended),
James Cook University,
Townsville, Queensland,
Australia*

*B.Sc. (Hons), James Cook
University, 1986*

Languages

English – Fluent

Golder Associates Ltd.

John is an Associate, and senior water quality specialist in the Calgary office. He has over 20 years of experience undertaking and managing surface water quality and limnological assessments of river and lake, and inshore marine environments.

John has been with Golder for almost 7 years. Prior to joining Golder, John spent the majority of his professional career working on the east coast of northern Australia at the Australian Centre for Tropical Freshwater Research at James Cook University, Townsville, Queensland. While at the Centre, John managed the consulting component of the business, as well as its analytical service laboratory, and collaborated on a number of research projects that focused on freshwater and marine environments. Pertinent work John undertook while at the Centre included an assessment of effects of mining and refinery operations to freshwater and inshore marine environments, an assessment of effects of agricultural runoff to coastal rivers and nearshore environments.

Since joining Golder, John has worked as a component lead, project manager, senior technical advisor, and technical director for projects involving water quality baseline and assessment studies and environmental impact assessments. These projects have focused on mining and municipal industries. John's work has predominantly been associated with baseline and environmental assessments in north-western Canada; these include the environmental assessment and permitting process for the De Beers Gahcho Kué Diamond Mine Project, the De Beers Snap Lake Diamond Mine Aquatic Effects Monitoring Program, the environmental assessment for the Fortune NICO Project, and an investigation of Tailings Lake at the former Colomac Mine site for DIAND. John has also provided senior technical support to projects associated with the annual environmental monitoring program for the City of Edmonton, and to environmental impact assessments for uranium mining projects in Saskatchewan and Ontario.

Throughout his career, John has authored or co-authored a number of journal articles and conference publications. He has prepared numerous technical reports and been involved in a number of workshops that have focused on water quality investigations, water and sediment sampling, and analytical techniques.

Employment History

Golder Associates Ltd. – Calgary, Alberta
Senior Water Quality Scientist (2007 to Present)

Responsible for the design, implementation, management, and interpretation of water quality investigations, including environmental baseline studies and components of environmental impact assessments (EIAs); project coordination and management; report preparation; and senior review of aquatic assessment reports.



Australian Centre for Tropical Freshwater Research James Cook University – Townsville, Queensland

Senior Water Quality Scientist / Water Quality Laboratory Manager (2002 to 2007)

Responsible for the design, implementation, management, and interpretation of commercial, municipal and industrial water quality assessments, environmental baseline studies and EIAs, and water quality research projects. Duties included external project development and management, staff management, report preparation, and public presentations. Concurrently managed a water quality laboratory that was responsible for water and sediment quality analysis.

Australian Centre for Tropical Freshwater Research James Cook University – Townsville, Queensland

Water Quality Scientist/Chemist (1988 to 2002)

Assisted in the design, implementation, management, and interpretation of water quality research projects. Duties included planning and undertaking field surveys, laboratory analyses of water and sediment quality analyses, and preparation of proposals and reports.

Department of Zoology James Cook University – Townsville, Queensland

Research Assistant - Hydrobiologist/Chemist (1987 to 1988)

Developed a research program for a limnological assessment of a newly formed, highly turbid reservoir. Conducted monthly surveys of water quality and lower trophic community monitoring, carried out associated laboratory work, and reported results.

Department of Botany James Cook University – Townsville, Queensland

Research Assistant / Demonstrator - Plant Physiology (1986 to 1987)

Aided in a program utilizing gel electrophoresis to map effects to amino acid distribution in C4 plants as a result of sodium deficiency. The position also demonstrated to third-year plant physiology practical classes.

Department of Geology James Cook University – Townsville, Queensland

Research Assistant (1985 to 1986)

Aided in a research program investigating the occurrence of crown-of-thorn starfish skeletal remains in vibra-core reef sediment samples collected from the Great Barrier Reef to determine outbreak frequency in recent history.



PROJECT EXPERIENCE – VARIOUS

**Elizabeth Falls Project
- EA SaskPower**
Saskatoon,
Saskatchewan, Canada

A team member providing senior review and technical support to the water quality component lead of the EIS (2013).

**River Morphology and
Physical
Oceanography
Baseline Study, Farim
Phosphate Project GB
Minerals Ltd.**
Guinea-Bissau

A team member providing senior review and technical support to the water quality component (2013).

**Gahcho Kué Project De
Beers Environmental
Impact Statement (EIS)**
Gahcho Kué, Northwest
Territories, Canada

The Aquatics Coordinator for the initial EIS phase of the Project (2007 to 2009) responsible for the organization, management and preparation of the aquatic components of the EIS. Part of the responsibility included managing an external consultant was retained by De Beers for completion of several of the aquatic component sections for the EIS. This EIS project was put on hold by De Beers in 2009.

The project was reinitiated in 2010. My responsibility through to 2012 under the renewed project was as Technical Director leading the Golder technical team through a rewrite of the EIS and through the EIR process with MVEIRB, including the MVEIRB technical sessions and regulatory hearing for the project.

The director role has now extended into 2014 to leading the Golder technical team through the project permitting process assisting De Beers in the Water Licence, Land Use Permit, and Fisheries Authorization approval process with the MVLWB and DFO.

**Snap Lake AEMP -
Regulatory Support**
Snap Lake, Northwest
Territories, Canada

A team member providing senior review and technical support to the water quality component lead of the AEMP (since 2008).

**North Saskatchewan
River Monitoring
Program, City of
Edmonton**
Edmonton, Alberta,
Canada

A team member (since 2007) providing senior review and technical support to the project team responsible for various projects completed for the City including the environmental monitoring program (EMP), which reports the results of municipal loading to the North Saskatchewan River on an annual basis.

The role has developed from undertaking the reporting for the EMP, to the senior technical role for water quality-related issues for the EMP, and additional City projects such as the Intensive Intake Monitoring Program, and the Kennedale and Pylypow Wetland Monitoring Program.

**Giant Mine MMER
Annual Reporting
Program, Giant Mine**
Yellowknife, Northwest
Territories, Canada

A team member providing senior review and technical support to the water quality component lead (since 2010).



**Wabamun Regional
Biomonitoring
Program, Stantec**
Alberta, Canada

A team member providing senior review and technical support to the water quality component lead (since 2009).

**Baseline/EA Fortune
NICO Project**
Northwest Territories,
Canada

Water quality component lead (2009 to 2014) involved in the completion and reporting of water quality baseline data and water quality assessment for the EIS. Participated in the MVEIRB technical sessions and regulatory hearings, and the MVLWB permitting technical sessions and regulatory hearings for the project.

**Contaminants
Sampling Program BP
Project**
Beaufort Sea, Nunavut,
Canada

A team member providing senior review and technical support to the field and data analysis component leads of the contaminants program (2011 and 2012).

**Gap Analysis/Baseline
Program, Groundbirch
Project, Shell Canada
Ltd.**
British Columbia,
Canada

A team member providing senior review and technical support to the water quality component for the gap analysis and baseline program (2010 and 2011).

**Water Quality Baseline
Study – Exploration
Ramp Project,
STRATECO**
Matoush, Ontario,
Canada

A team member providing senior review and technical support to the water quality component lead for the project (2009 and 2010).

**Tailings Lake
Investigation –
Colomac Minem,
DIAND-CARD**
Yellowknife, Northwest
Territories, Canada

A team member providing senior review and technical support to the water quality component lead for the project (2009 and 2010).

**McArthur River Ore
Haulage Project
Description, AREVA
Resources**
Saskatoon,
Saskatchewan, Canada

A team member providing technical support to the environmental assessment process in the development of project descriptions and EIAs for uranium mining developments in northern Saskatchewan in 2009.

**Baseline Program
UTS/Teck Cominco
Equinox Project**
Oil Sands, Alberta,
Canada

Water quality component lead (2008 to 2011) involved in the organization, management and preparation of the baseline for the proposed Equinox Oil Sands development. Also responsible for providing support and coordination for the Pilot Plant testing program that will service the UTS/Teck Equinox and Frontier Oil Sands developments.



**Annual Aquatic Studies Program
Newmont/Miramar
Hope Bay Project**
Hope Bay, Nunavut,
Canada

A team member providing senior review and technical support to the water quality component of the annual aquatic studies programs from 2006 to 2008.

**Millennium Mine
Project Proposal
Cameco Corporation**
Saskatoon,
Saskatchewan, Canada

A team member responsible for providing technical support for the environmental assessment process in the development of the project proposal for the Millennium Mine development in northern Saskatchewan (2009 and 2010).

SUPPLEMENTAL SKILLS

Research Experience

Areas of specific research interest include the limnology of tropical lakes and reservoirs, water quality processes, the assessment of trophic status of tropical freshwater systems, low-level nutrient analyses.

Specific projects include:

Assessment of water and sediment quality in tropical catchments on the eastern coast of north Queensland, as well as ephemeral water courses in north-western Queensland.

Assessment of water quality of runoff from plot and sub-catchment scale watersheds during wet season rain events and effects to receiving waters.

Assessment of water quality during event flow conditions of coastal rivers and inshore environment using a variety of sampling strategies, including catchment-based community volunteer sampling.

Limnological assessment of tropical reservoirs and lakes.

Development of automated low-level nutrient analyses to improve the sensitivity of current analytical methods for fresh, marine and estuarine waters (e.g. nitrate, nitrite, ammonia, filterable reactive phosphorus, silica, total nitrogen and phosphorus).

A review of constructed wetland systems to determine more efficient removal processes of phosphorus from wastewater.

Consulting Experience

Experience as a water quality scientist in tropical north-eastern Australia and western/north-western Canada with proven expertise in the sampling and analyses of marine and freshwaters for a variety of water and sediment quality indicators, interpretation and assessment.

General examples of projects include:

Seasonal limnological assessment of watersheds within, and adjacent to, metalliferous mining and refinery operations to meet environmental regulatory requirements.

Assessment of ship loading effects to bed sediment in a harbour environment to determine extent of spillage/discharge effects.

Assessment of sugar mill effluent ponds and design of mitigation features to reduce



odour problems.

Assessment of aquatic ecosystem health elements of various environmental impact studies (e.g. coastal developments, water supply infrastructure), including water quality, sediment quality and lower trophic community quality components.

Review of environmental factors for state development projects, including highway upgrades.

Assessment of the effects of fertilizer treatments to runoff quality from sugar cane farms.

PROFESSIONAL AFFILIATIONS

Australian Society of Limnology

Australian Water Association

Canadian Society of Limnology

Society of International Limnology

International Water Association

PUBLICATIONS

Conference Proceedings

Lewis, S. E., J. E. Brodie, Z. T. Bainbridge, A. M. Davis, J. W. Faithful, L. Liessman, K. Rohde and B. Masters. 2008. *Herbicide residues in waterways draining sugarcane catchments of the Great Barrier Reef*. . Proceedings of the 5th SETAC World Congress., 3-7 August. Sydney, Australia.

Hately, L.R., J.D. Armour, J. Brodie, J.W. Faithful, G.L. Pitt and P.N. Nelson. 2007. *Modelling, monitoring and sediment tracing in the Tully River catchment, north Queensland: a comparison of techniques*. 2007 International Congress on Modelling and Simulation. Modelling and Simulation Society of Australia and New Zealand, December . Auckland, New Zealand.

Brodie, J., A.G. Dekker, V.E. Brando, B. Masters, J.W. Faithful, R. Noble and K. Rohde. 2006. *Extent and duration of the algal bloom in the Great Barrier Reef lagoon following river discharge events in the Mackay Whitsunday's Region, Australia*. 13th Australasian Remote Sensing and Photogrammetry Conference: Earth Observation – from Science to Solutions, November. Canberra.

Cooper, M., G. Shields, J.W. Faithful and J. Zhao. 2006. *Using sediment Sr/Nd isotopic ratios to determine sediment sources in the Burdekin Falls Dam, Queensland, Australia*. 16th Annual V.M. Goldschmidt Conference, August - September. Melbourne, Australia.

Cooper, M., J.W. Faithful, T. Steiglitz and G. Shields. 2005. *Sediment Dynamics of a Large Tropical River System: The Burdekin River and Lake Dalrymple, Australia*. Tenth International Symposium on the Interactions between Sediment and Water, August –September. Bled, Slovenia.



Taylor, J., T. Lloyd, A. Melzer and J.W. Faithful. 2004. *Conserving ecosystems and managing biodiversity in industrial land and seascapes – Yabulu Nickel Refinery experience*. Minerals Council of Australia, Inaugural Global Sustainable Development Conference, October. Melbourne, Australia.

Lukacs, G.P., C. Perna and J.W. Faithful. 2004. *Coastal wetlands of north-eastern Australia: Condition and management interventions*. Seventh Intecol International Wetlands Conference, July. Utrecht, The Netherlands.

Faithful, J.W. and W. Finlayson. 2004. *Water quality assessment for sustainable agriculture in the Wet Tropics – A community-assisted approach*. Catchment to Reef Conference, Great Barrier Reef Marine Park Authority, March. Townsville.

Faithful, J.W. and D. Burrows. 2003. *From Blue to Brown: Persistently Elevated Turbidity Resulting from Damming the Tropical Burdekin River*. Ninth International Conference on River Research and Applications, July. Albury.

Connor, R., J. Milsom, A. Melzer, B.M. Butler, J.W. Faithful, W. Dennison, T. Lloyd and G. Swain. 2003. *Ecosystem-based assessment and management of marine and estuarine systems at the QNI Yabulu Nickel Refinery, Townsville*. 2nd National Conference on Aquatic Environments: Sustaining our aquatic environments – Implementing Solutions. Queensland Department of Natural Resources and Mines. Brisbane, Australia.

Journal Articles

J.W., Faithful and Griffiths D.J. (in preparation) The influence of season on the variability of suspended solids concentrations within a highly turbid tropical reservoir.

J.E., Brodie, Schroeder T., Rohde T., Faithful J.W., Masters B., Dekker A., Brando V. and Maughan M. Dispersal of suspended sediments and nutrients in the Great Barrier Reef lagoon during river discharge events: conclusions from satellite remote sensing and concurrent flood plume sampling. *Marine and Freshwater Research*, 61 (2010), 651-664.

A., Mitchell, Reghenzani J., Faithful J.W., Furnas M. and Brodie J.E. Relationships between land use and nutrient concentrations in streams draining a 'wet-tropics' catchment in northern Australia. *Marine and Freshwater Research*, 60 (2009), 1097-1108.

Z.T., Bainbridge, Brodie J.E. , Faithful J.W., Sydes D.A. and Lewis S.E. Identifying the land-based sources of suspended sediments, nutrients and pesticides discharged to the Great Barrier Reef from the Tully-Murray Basin, Queensland, Australia. *Marine and Freshwater Research*, 60 (2009), 1081-1090.

P.J., O'Reagain, Brodie J., Fraser G., Bushell J.J., Holloway C.H., Faithful J.W. and Haines D. Nutrient loss and water quality under extensive grazing the upper Burdekin River catchment, north Queensland. *Marine Pollution Bulletin*, 51 (2005), 37-50.



J.W., Faithful and Finlayson W. Water quality assessment for sustainable agriculture in the Wet Tropics – A community approach. *Marine Pollution Bulletin*, 51 (2005), 99-112.

J.W., Faithful and Griffiths D.J. Turbid flow through a tropical reservoir (Lake Dalrymple, Queensland, Australia): responses to a summer storm event. *Lakes and Reservoirs: Research and Management*, 5 (2000), 231-247.

J.W., Faithful. Phosphorus in Wetlands - A Review. *Queensland Department of Natural Resources, Brisbane*, ISBN 0 7242 7414 6 (1997), 53pp.

D.J., Griffiths and Faithful J.W. Effects of the sediment load of a tropical north-Australian river on water column characteristics in the receiving impoundment. *Arch. Hydrobiol, Suppl. 113 Large Rivers* 10(1-4) (1996), 147-157.

P.D., Walbran, Henderson R.A., Faithful J.W., Polach H.A. and Sparkes R.J. Crown-of-Thorn starfish outbreaks on the Great Barrier Reef: a geological perspective based upon the sediment record. *Coral Reefs*, 8 (1989), 67-78.

Other

Faithful, J.W. (2000) A Summary of the Water Quality Monitoring Program of the Willows Gardens Ornamental Ponds, Townsville. ACTFR Report No. 00/06 for the Delfin Property Group, Townsville.

Faithful, J.W. and B.M. Butler (2000) Evaluation of Stormwater Quality on the Mount Stuart Training Area – 1999/2000 Wet Season. ACTFR Report 00/10 for the Department of Defence, Townsville.

Lukacs, G.L. and J.W. Faithful (2000) Bruce Highway Upgrade – Ayr – Townsville Development Application for Fill Extraction: Ecological Issues. ACTFR Report 00/11 for John Holland Pty. Ltd., Townsville.

Faithful J.W. and Butler B. (2000) A Brief Assessment of the Significance of a Small Inlet in Black Weir, Ross River, within the Riverside Gardens Development, Townsville. ACTFR Report 00/14 for Delfin, Townsville.

Faithful, J.W. and B.M. Butler (2001) Halifax Bay Water and Sediment Quality Study – September 2000. ACTFR Report 01/01 for Central Queensland University.

Faithful, J.W. (2001) Invicta Mill Settlement Ponds - An Assessment of Odour Production Problems and Options for Remediation. ACTFR Report No. 01/02 for CSR Invicta Mill

Dixon, D., Winkel, P. and J.W. Faithful (2001) Flora and Fauna Survey of the Rockhampton City Council's Lakes Creek Road Landfill Site. Wet Season Survey. ACTFR Report No. 01/05 for Maunsell McIntyre Pty. Ltd., Rockhampton.

Loong, D., Faithful, J.W. and J. Brodie (2001) An Assessment of Potential Water Quality Impacts by Motorised Watercraft in Ross River Dam - A Literature Review. ACTFR Report No. 01/09 for NQ Water, Townsville.



Faithful, J.W. and B.M. Butler (2001) Halifax Bay Water and Sediment Quality Study – September 2001. ACTFR Report 01/10 for Central Queensland University.

Burrows, D.B. and J.W. Faithful (2002) Townsville Field Training Area (TFTA) Ecological Monitoring – 2001 Pre-Wet Season Aquatic Ecology and Surface Water Quality and 2002 Post-Wet Season Sediment Quality. ACTFR Report No. 02/05 for the Department of Defence, Townsville.

Faithful, J.W., Loong, D. and C. Perna (2002) Ross River Aquatic Weeds Study – A Preliminary Assessment of the Impacts of Aquatic Weeds Harvesting on the Physico-Chemical and Chemical Water Quality of Ross River. ACTFR Report No. 02/09 for Maunsell Australia (Townsville) Pty. Ltd.

Faithful, J.W. (2002) Water Quality in the Townsville/Burdekin Dry Tropics Region. ACTFR Report No. 02/12 to Conservation Volunteers Australia, National Heritage Trust Project No. 2002153.

Faithful, J.W. (2002) Water Quality in the Whitsunday Rivers Catchments. ACTFR Report No. 02/13 to the Whitsunday Rivers Integrated Catchment Association, Proserpine, Queensland. A Coast and Clean Seas Project (1999 – 2002).

Loong, D. and J.W. Faithful (2003) An Assessment of Lead in the Sediment of Lake Paluma Following a Dam Works Incident. ACTFR Report No. 03/01 for NQ Water Pty. Ltd.

Faithful, J.W., Loong, D. and D. Burrows (2003) Mount Gordon Mine Dry Season Limnological Survey – December 2002. ACTFR Report No. 03/07 for Western Metals Mount Gordon Operation.

Faithful, J.W. (2003) Halifax Bay Water and Sediment Quality Study – November 2002. ACTFR Report 03/09 for Central Queensland University

Faithful, J.W. (2003) A Limnological Assessment of Kingfisher Lagoon - A Small Embayment in Black Weir, Ross River, Townsville. ACTFR Report No. 03/10 for Delfin Townsville Pty. Ltd.

Burrows, D.B. and J.W. Faithful (2003) Townsville Field Training Area (TFTA) Ecological Monitoring – Monitoring of Aquatic Ecology, Water and Sediment Quality on the Townsville Field Training Area, November 2002 to June 2003. ACTFR Report No. 03/12 for the Department of Defence, Townsville.

Loong, D. and J.W. Faithful (2003) Impacts of Motorised Watercraft on Ross Dam – Intensive Activity Survey. ACTFR Report No. 03/14 for NQ Water Pty. Ltd.

Faithful, J.W. (2003) A Follow-Up Limnological Assessment of Kingfisher Lagoon - A Small Embayment in Black Weir, Ross River, Townsville. ACTFR Report No. 03/17 for Delfin Townsville Pty. Ltd.



Faithful, J.W. and W. Finlayson (2003) Water Quality Assessment for Sustainable Agriculture - Tully-Murray Rivers Catchment Area and Granite Creek on the Atherton Tablelands. ACTFR Report No 03/18 for the Natural Resource Management Board (Wet Tropics) Inc., Innisfail, Project No. 2012015.

Loong, D. and J.W. Faithful (2003) Microbiological Status of Paluma Township Weirs. ACTFR Report No. 03/21 for Thuringowa City Council.

Faithful, J.W. (2004) Halifax Bay Water and Sediment Quality Study – Pre-Wet Season 2003 and Post-Wet Season April 2004. A Component of a Multi-Disciplinary Southern Halifax Bay Ecological Assessment as part of the Environmental Assessment and Management Program for Queensland Nickel Pty. Ltd. ACTFR Report 04/03 for Central Queensland University.

Brodie, J., Faithful, J.W. and K. Cullen (2004) Community Water Quality Monitoring in the Burdekin River Catchment and Estuary, 2003 – 2004. ACTFR Report No. 03/16 for The Queensland Department of Primary Industries and Fisheries and the Burdekin Dry Tropics.

Post, D.A., Loong, D., Burrows, D., and J.W. Faithful (2004) Ecological Monitoring of the Townsville Field Training Area (TFTA) 2003/04. CSIRO Land and Water and ACTFR Report No. 590 for the Department of Defence.

Faithful, J.W., Loong, D., Davis, A. and D.B. Burrows (2004) Mount Gordon Mine Dry Season Limnological Survey, June/July 2004. ACTFR Report No. 04/12 for Aditya Birla Copper, Mount Gordon Operations.

Brodie, J., Bainbridge, and J.W. Faithful (2005) Community Monitoring of Suspended Solids and Nutrients in the Sub-Catchments of the Burdekin Region from the January Flood Event, 2005. ACTFR Report No. 05/01 for the Department of Natural Resources, Mines and Energy, Queensland.

Faithful, J., Brodie, J., Armstrong, C., Bubb, K., and P. Frayne (2005) Nutrient Concentrations in the 2003-04 Wet Season Run-Off Draining a Pine Plantation in the Wet Tropics. ACTFR Report No. 05/02 for Queensland Department of Primary Industries - Forestry.

Faithful, J.W. (2005) Halifax Bay Water and Sediment Quality Study – Pre-Wet (October/November 2004) and Post-Wet Season (April 2005). ACTFR Report No. 05/04 for the Centre for Environment Management, Central Queensland University.

Loong, D., Butler, B., Burrows, D., Faithful, J.W. and A. Davis (2005) Limnological Assessment and Benchmarking of Key Sentinel Wetlands in the Burdekin Catchment. ACTFR Report No. 05/09 for Burdekin Dry Tropics, Ayr, Queensland.

Faithful, J.W., Davis, A. and D. Loong (2005) Page Creek Post-Wet Season Limnological Survey, March 2005. ACTFR Report No. 05/10 for Zinifex Century Ltd.



Faithful, J.W., Davis, A. and D. Loong (2005) Mount Gordon Mine Dry Season Limnological Survey, June/July 2005. ACTFR Report No. 05/11 for Aditya Birla Copper, Mount Gordon Operations.

Post, D.A., Loong, D., Burrows, D. and J.W. Faithful (2005) Ecological Monitoring of the Townsville Field Training Area (TFTA) 2003/04: Monitoring of Water Quality, Aquatic Invertebrates and Riparian Vegetation on the Townsville Field Training Area November 2004-July 2005. CSIRO Land and Water and ACTFR Client Report for the Department of Defence.

Rohde, K., Masters, B., Brodie, J., Faithful, J.W., Noble, R. and Carroll, C. (2006) Fresh and Marine Water Quality in the Mackay Whitsunday Region 2004/2005. Mackay Whitsunday Natural Resource Management Group, Mackay, Australia.

Brodie, J. Bainbridge, Z. Lewis, S.E. Post, D. Duncan, I. Faithful, J.W. and Furnas, M. (2006) Community Monitoring of Suspended Sediments and Nutrients in the Sub-Catchments of the Burdekin Region from the January Flood Event, 2005. ACTFR Report No. 06/01.

Faithful, J.W. (2006) Review of Groundwater Monitoring Data, Sun Metals Zinc Refinery – 2005. ACTFR Report No. 06/03 for Sun Metals Corporation, Townsville.

Faithful, J.W. (2006) Halifax Bay Water and Sediment Quality Study – Pre-Wet (December 2005) and Post-Wet Season (February/March and April 2006). ACTFR Report No. 06/04 for the Centre for Environment Management, Central Queensland University.

Faithful, J.W. and T. McShane (2006) Fate of Nutrients in BioDunder and Liquid One-Shot Hi-N – Preliminary Field Trial, November 2005 to January 2006. ACTFR Report No. 06/12. A combined ACTFR/BBIFMAC/MAFIA Project for CSR Ethanol.

Bainbridge, Z., Lewis, S., Brodie, J., Faithful, J.W. and M. Maughan (2006) Monitoring of Sediments and Nutrients in the Burdekin Dry Tropics Region: 2005/06 Wet Season. ACTFR Report No. 06/13 for the Burdekin Dry Tropics NRM. Australian Centre for Tropical Freshwater Research, James Cook University, Townsville.

Faithful, J.W., Brodie, J., Hooper, A, Leahy, P., Henry, G., Finlayson, W. and D. Green (2006) Plot-Scale Runoff of Nutrients and Sediment Under Varying Management Regimes on a Banana and Cane Farm in the Wet Tropics, Queensland, November 2002 to July 2006. An ACTFR Project for Task 1, Catchment to Reef Project. ACTFR Report No. 05/03.

Faithful, J.W., Davis, A. and D. Loong (2006) Page Creek Post-Wet Season Limnological Survey, May 2006. ACTFR Report No. 06/16 for Zinifex Century Ltd.



Faithful, J.W., Davis, A. and D. Loong (2006) Mount Gordon Mine Dry Season Limnological Survey, July 2006. ACTFR Report No. 06/17 for Aditya Birla Copper, Mount Gordon Operations.

Post D.A., Loong, D., Dowe, J., Hodgen, M., Keen, R., Hawdon, A., Petheram, C., Burrows, D. and J.W. Faithful (2006). Ecological Monitoring of the Townsville Field Training Area (TFTA) 2005/06. CSIRO Land and Water and ACTFR Client Report to Department of Defence, November 2006

Faithful, J.W., Liessmann, L., Brodie, J. and D. Sydes (2007) Water Quality Characteristics of Water Draining Different Land Uses in the Tully/Murray Rivers Region. ACTFR Report No. 06/25 for the Tully Water Quality Improvement Plan.

Faithful J.W. and D. Loong (2007) Water Quality Characterisation of the Surface Waters in Aquatic Habitats Located Within the Yabulu Nickel Refinery. A Limnological Survey – 2005/06. ACTFR Report No. 07/02 for Queensland Nickel Industries Pty.

Brodie, J., Mitchell, A.W., Lewis, S., Bainbridge, Z., Faithful, J.W., Hateley, L., Armour, J., Maughan, and J. Reghenzani (2007) Water Quality Issues in the Tully Region. ACTFR Report No. 07/04 for FNQNRM Tully Coastal Catchment Initiative.

Mitchell, A.W., Brodie, J. and J.W. Faithful (2007) Testing simple sediment and nutrient methods for landholder use. ACTFR Report No. 07/06 for the National Heritage Trust

Liessmann, L. Lewis, S., Bainbridge, Z., Butler, B., Brodie, J., Faithful J.W. and M. Maughan (2007) Event-based water quality monitoring of the Ross and Black River Basins during the 2006/07 wet season. Volume 1 - Main Report and Volume 2 – Appendices. ACTFR Report 07/09 for the Creek to Coral Ross Black Water Quality Improvement Plan.

Loong, D. and J.W. Faithful (2007) Halifax Bay Water and Sediment Quality Study 2006-2009. Pre-Wet Season (December 2006) and Post-Wet Season (February-May 2007). A Component of a Multi-Disciplinary Southern Halifax Bay Ecological Assessment as part of the Environmental Assessment and Management Program for Queensland Nickel Pty. Ltd. (QNI). ACTFR Report No. 07/13 for Queensland Nickel Pty. Ltd. (QNI).

Faithful J.W., Liessmann, L., Brodie, J., Ledee, E., Maughan, M., and D. Sydes (2008) Water Quality Characteristics of Water Draining Different Land Uses in the Tully/Murray Rivers Region - Edition 2. ACTFR Report 08/03 for the Tully Water Quality Improvement Plan.



Education

M.Sc. Geology, McMaster University, Hamilton, Ontario, 2002

B.Sc. (Hons) Geology, McMaster University, Hamilton, Ontario, 2000

Languages

English – Fluent

Spanish – Fluent

; c`XYf`5 ggcWjUHg`@X"

Golder Associates Ltd. – Burnaby, British Columbia
Geochemist – Mine Water Management Group (2008 to Present)

Golder Associates Ltd. – Mississauga, Ontario
Geochemist – Mine Waste Environmental Group (2004 to 2007)

Responsible for mine waste characterization, acid generation/metal leaching prediction and water quality tasks that included field sample collection, laboratory coordination, data analysis and report preparation.

Worked on geochemical assessment projects in support of studies for various levels of mining: i.e., scoping studies, feasibility studies, baseline studies, environmental impact assessments (during the construction period, operations, closure/post-closure phases), permitting, operational compliance monitoring and closure plans.

Conducted studies, which included probabilistic and deterministic modelling of geochemical interactions of surface water and groundwater hydrology and water treatment related to mining environments.

Conducted field investigations including waste rock geochemical characterization, geotechnical soil/rock core logging, piezometer installation, conductivity testing and sampling in soil, rock, groundwater and surface water.

Prepared proposals, budgets and schedules for large multidisciplinary and smaller-scale projects.

Gartner Lee Ltd. – Burnaby, British Columbia
Geochemist (2007 to 2008)

Responsible for geochemical and water quality studies in support of mine permit applications and other studies at the various stages of mining including baseline, scoping, feasibility, closure and site reclamation.

Presented technical results to and discussed mine water and waste management strategies with regulatory agencies.

Prepared technical reports and memorandums as part of baseline, feasibility, site reclamation and closure studies that included field sample collection, laboratory coordination, and data analysis.

Developed probabilistic and deterministic geochemical models in support of mine treatment design criteria and water management strategies.

Conducted field studies including waste rock sample collection, mini-piezometer and piezometer installation, and sampling of various media including soil, surface and groundwater.

Managed large- and small-scale projects that required budget tracking and supervision of junior administrative and GIS staff involved in related task work.

Responsible for communicating technical results and project status information to clients in a timely manner.

Prepared proposals, budgets and schedules for large, multidisciplinary and small-scale projects.

School of Geography & Geology, McMaster University – Hamilton, Ontario

Sessional Lecturer (2003 to 2004)



Crystallography and Optical Mineralogy – Fall 2003

(Optical properties, structure, chemistry and paragenesis of rock forming minerals).

The Earth and the Environment – Spring 2003 & 2004

(Introductory geology and environmental science course, which included a mandatory field trip).

School of Geography & Geology, McMaster University – Hamilton, Ontario

Instructional Assistant (2002 to 2004)

Supported the ongoing instructional activities of the School of Geography and Geology.

Assisted with the preparation of course materials and created rock and mineral identification labs.

Demonstrated and instructed laboratory and field techniques.



PROJECT EXPERIENCE – MINING

- Gahcho Kue**
NWT, Canada

Responsible for the projection of surface site and downstream water quality for a proposed diamond mine to evaluate project impacts to surface water quality as part of the EIA. Michael was responsible for presenting and defending the water quality predictions to the MVEIRB and other stakeholders as part of the permitting process.
- Quinsam Coal**
Campbell River, BC

Responsible for the prediction of surface site and downstream water quality resulting from an expansion to existing operations at the Quinsam Coal Mine. Water quality predictions were developed to support an amendment to the existing environmental permit and Michael was responsible for presenting and defending the water quality predictions to several regulatory bodies and non-governmental organizations as part of the permitting process.
- Xstrata Copper**
Arequipa, Peru

Responsible for the prediction of surface water quality impacts to downstream receptors from a proposed copper mine in Southern Peru. Project work involved development of detailed pit lake and downstream receiving water quality models, interpretation and reporting of modelled results.
- PERCAN**
Lima, Peru

Responsible for managing the environmental activities for the Peru-Canada Mineral Sectors Reform Project. Project work included authoring technical guidance documents, training of ministry staff on existing environmental guidelines and assisting the Peruvian Ministry of Energy and Mines to advance their abandoned mine site inventory. Responsible for managing a large team of technical professionals from Canada and Peru.
- Eldorado Gold**
Efemcukuru, Turkey

Use of spreadsheet and geochemical models to predict site water quality for an underground gold mine in Turkey. Project work included development of a conceptual model based on existing documentation and creating a site-wide geochemical model that incorporated all of the proposed mine components. Simulated results supported detailed design of a water treatment plant.
- Xstrata Copper**
Arequipa, Peru

Responsible for identification and collection of geochemical rock samples to support geochemical baseline studies as part of an Environmental Impact Assessment for a proposed open pit copper mine.
- Barrick Gold**
Trujillo, Peru

Responsible for identification and collection of geochemical rock samples to support geochemical baseline studies as part of an Environmental Impact Assessment for a proposed open pit gold mine.
- Newmont**
Cajamarca, Peru

Responsible for identification and collection of geochemical rock samples to characterize the expected environmental conditions of non-contact diversion channels. Project work included sample collection, laboratory coordination, result interpretation and documentation, which included remediation recommendations and alternatives in support of a bankable feasibility study.
- Minera Panama S.A.**
Penonome, Panama

Responsible for identification and collection of geochemical rock samples to support geochemical baseline studies for a proposed open pit copper mine. Assisted with baseline water quality data collection, interpretation and reporting in support of an Environmental Impact Assessment. Developed detailed site-wide water quality and receiving water quality models to predict the impacts of the project to the downstream surface water quality.



Redfern Resources British Columbia, Canada	Lead geochemist responsible for documenting existing geochemical data and providing simulated water qualities in support of Environmental Management Act and Mine's Act permits. Was required to meet with regulatory agencies to present supporting documentation related to construction permit applications.
Barrick Gold Nunavut, Canada	Lead geochemist responsible for identifying ARD issues at a closed and reclaimed mine site in Nunavut, Canada. Project work included a site visit to assess the existing conditions, collect representative samples and coordinate geochemical testing. A final document was required to present the current conditions, geochemical results and to present recommendations for further site remediation.
Western Copper Corporation Yukon, Canada	Development of a characterization program for assessing the acid generation and metal leaching potential of mine waste materials including static and kinetic testing for an open pit gold mine in Yukon, Canada. Project work included indentifying rock core sample intercepts and coordinating testing of tailings materials to support baseline EIA studies.
Atlantic Gold Touquoy, Nova Scotia	Development of a characterization program for assessing acid generation and metal leaching of mine waste materials including static and kinetic testing for an open pit gold mine in Nova Scotia, Canada. Project work included collection of rock core for testing, prediction of waste geochemical behavior, organizing, administering and interpreting geochemical results in support of a bankable feasibility study.
Barrick Gold Buzwagi, Tanzania	Involved in geochemical characterization programs of mine wastes at an open pit gold mine in Tanzania including, processing and interpretation of large data set of geochemical results. Project work included developing a water quality model using GoldSim for water quality impact assessment and assisting in authoring technical sections facilitating the client's regulatory requirements in international operations for baseline and EIA studies.
Barrick Gold Alto Chicama, Peru	Assisted with the management of ongoing kinetic geochemistry data to determine the acid rock drainage potential of waste materials. Project work included analysis and reporting of humidity cell data.
Tiberon Minerals Ltd. Nui Phao, Vietnam	Involved in processing and interpretation of static and kinetic geochemical laboratory results for characterization of mine wastes for an open pit bismuth/tungsten mine in Vietnam. Project work included developing a site wide water quality model and assisting with authoring of geochemistry and water quality reports as a part of the client's Feasibility Study.
St. Andrew Goldfields Ltd. Timmins, Ontario	Assisting with the development of a field testing program which included drilling, test pitting and piezometer installation. Collected soil samples and measured hydraulic conductivities in all installations. Project work included interpretation of groundwater and surface water quality data and authoring of supporting documentation for the client's application for a Permit to Take Water.
DeBeers Snap Lake, NWT	Use of spreadsheet and geochemical models to predict site water quality for an underground diamond mine in NWT. Work included managing and maintaining large geochemical databases used in the development of a trend analysis model to ensure recent measured samples agree with EIA predictions.



Teck Cominco Ltd. Red Lake, Ontario	Implemented a field program consisting of overburden drilling, piezometer installation, test pitting, and surface and groundwater sample collection to support the client’s regulatory requirements as part of the mine closure plan. Other project work included interpretation and reporting of the field testing program results.
Antamina Mine Antamina, Peru	Assisted with the development of a GoldSim water quality model to predict metal loading from a large copper-zinc mine in northern Peru and examining drill-core data to assist with implementation of future drilling programs.
Encana Lorado Mine, Saskatchewan	Developed a GoldSim water quality model to assess various remediation options of a site containing a lake under acidic conditions. Project work included processing and interpretation of static geochemistry data and assisting with authoring of technical sections.
Kumtor Operating Company Kumtor, Kyrgyzstan	Assisted in annual updates of a tailings dam study for a gold mine in Kyrgyzstan. Project work included assessment of surface and groundwater quality data and assisting in authoring technical sections facilitating the client's regulatory requirements in international operations for mine site effluents.
Falconbridge Ltd. Koniambo, New Caledonia	Use of spreadsheet and geochemical models to predict the preliminary site water quality for a nickel mine in New Caledonia.

TRAINING

MEND Annual ARD Workshop

December 2008

7th International Conference on Acid Rock Drainage

March 2006

Metal Leaching and Acidic Drainage

Ontario Ministry of Northern Development and Mines, February 2005

Other Professional Development Courses

Project Management, 2006

Environmental Site Assessment, 2007

H&S Training (First Aid, Hazard Assessment & Risk Evaluation, Field Inspections)

PROFESSIONAL AFFILIATIONS

Member, Association of Professional Engineers and Geoscientists of the Province of British Columbia (APEGBC)

PUBLICATIONS

Herrell, M.K., Salzsauler, K.A., McRae, C. A Practical Application of Mass-Balance Methods for Predicting Mine Drainage Water Quality – Climate Influences and Best Practices. Poster presentation at the 9th ICARD, Ottawa, Canada 2012.



Herrell, M.K., McRae, C., Salzsauler, K.A., Waples, J.S., 2009. Practical Application of Accelerated Methods of Acid Rock Drainage and Metal Leaching Prediction of Mine Materials. Paper presented at the 2009, Securing the Future and 8th ICARD, June 22-26, 2009, Skelleftea, Sweden.

Herrell, M.K., Dickin, A.P., Morris, W.A. 2006. A test of detailed Nd isotope mapping in the Grenville Province: delineating a duplex thrust sheet in the Kipawa-Mattawa region. *Can. J. Earth Sci* 43(4): 421-432.



Education

*B.Sc. Biology (Honours),
University of Windsor,
Canada, 1987*

*M.Sc. Biology, University of
Windsor, Canada, 1990*

Languages

English – Fluent

Golder Associates Ltd.

Mr. Kovats is a senior water quality specialist and aquatic ecologist with two decades of professional experience. His water quality experience is mostly in the area of water and sediment quality monitoring for resource developments, and environmental assessments for in situ oil sands projects, mines, pipeline projects and power developments in western and northern Canada. As an aquatic ecologist, he specializes in lower trophic community monitoring, with an emphasis on benthic invertebrate monitoring as part of Environmental Effects Monitoring studies for pulp mills and metal mines, Aquatic Effects Monitoring Programs for diamond mines, and a variety of other monitoring projects. Mr. Kovats has extensive aquatic field experience in streams, rivers and lakes, and a strong background in the statistical analysis and interpretation of water chemistry, sediment chemistry and biological monitoring data. Currently, his primary project role is senior reviewer, project/component director and technical advisor. He is also an experienced technical editor and has participated in regulatory hearings as an expert witness.

Employment History

Golder Associates Ltd. – Calgary, Alberta

Aquatic Ecologist, Associate since 2005 (1992 to Present)

Oversight, design, implementation, management, and interpretation of water quality and lower trophic community studies, including environmental baseline studies, components of environmental impact assessments and monitoring of the effects of physical/chemical disturbances on aquatic ecosystems; provision of general aquatic ecology and water quality expertise to ecological risk assessments, environmental impact assessments and aquatic ecosystem monitoring projects; senior review and technical editing of water quality and aquatic assessment reports.

International Joint Commission – Windsor, Ontario

Junior Physical Sciences Officer (1991 to 1992)

Literature review and preparation of report on degradation of benthic communities in Great Lakes connecting channels; contributions to various reports of the Science Advisory Board and the Council of Great Lakes Research Managers; preparation of 1990/91 Great Lakes - St. Lawrence Research Inventory.

Great Lakes Institute, University of Windsor – Windsor, Ontario

Research Assistant - Project Coordinator (1990 to 1991)

Organization and participation in field sampling programs, coordination of laboratory activities, data compilation and management, report preparation; development of mass culture techniques for aquatic invertebrates.



University of Windsor – Windsor, Ontario

Graduate Teaching Assistant (1987 to 1990)

Great Lakes Institute, University of Windsor – Windsor, Ontario

Research Assistant - Organic Chemistry Laboratory (1986)

Sample preparation for gas chromatographic analysis (freshwater mussels, aquatic insects); field sampling (aquatic invertebrates, sediment).



PROJECT EXPERIENCE – OIL SANDS

CNRL Birch Mountain East In Situ Project EIA
Fort McMurray, Alberta, Canada
Water quality component director and senior reviewer for water quality and air emission effects components. Contributed to supplemental information responses.

Cenovus Pelican Lake Grand Rapids Project EIA
Fort McMurray, Alberta, Canada
Water quality component director and senior reviewer for water quality and air emission effects components. Contributed to supplemental information responses.

Cenovus Narrows Lake In Situ Project EIA
Fort McMurray, Alberta, Canada
Water quality component director and senior reviewer for water quality and air emission effects components. Contributed to supplemental information responses.

Cenovus Christina River Thermal Project Phases E, F, G and H EIAs
Fort McMurray, Alberta, Canada
Water quality component director and senior reviewer for water quality and air emission effects components. Contributed to supplemental information responses.

CNRL Kirby North In Situ Project EIA
Fort McMurray, Alberta, Canada
Water quality component director and senior reviewer for water quality and air emission effects components. Contributed to supplemental information responses and attended meetings with stakeholders.

Preliminary Assessment of Oil Sands Tailings Pond Leachate on Athabasca River Benthos
Fort McMurray, Alberta, Canada
Field survey and literature review to assess the potential biological impacts of tailings pond leachate on benthic invertebrates, including an assessment of porewater contamination from natural and human sources.

Leming Lake Study
Cold Lake Region, Alberta, Canada
Review of historical water quality data and evaluation of potential causes of a decline in water level in Leming Lake.

Steepbank Mine EIA
Fort McMurray, Alberta, Canada
Coordination of the water quality and benthic invertebrate field programs for the baseline component of the EIA, including preparation of corresponding sections of the baseline report; writing team member for the water quality component.

Aurora Mine EIA
Fort McMurray, Alberta, Canada
Coordination of the water quality and benthic invertebrate field programs for the baseline component of the EIA, including preparation of corresponding sections of the baseline report. Also evaluated impacts of the new mine to water quality and aquatic ecosystem health; writing team member for the water quality component.



**Effects of Oil Sand
Reclamation Waters on
Wetlands**

Fort McMurray, Alberta,
Canada

Assisted with study design, data analysis and interpretation of biological and water quality data for this investigation of the effects of consolidated tailings release water on a wetland that formed on a reclaimed area of the Suncor oil sands operation.

**Shipyard Lake
Baseline Study**

Fort McMurray, Alberta,
Canada

Baseline study of a wetland that may be affected by future oil sands developments. Assisted with study design and analysis and interpretation of water quality, benthic invertebrate and plankton data.

**Limnological Study of
a Tailings Pond**

Fort McMurray, Alberta,
Canada

Assisted with water quality and biological data interpretation during this study of a tailings pond containing consolidated tailings release water from an oil sands operation.

**Oil Sands Regional
Aquatic Monitoring
Program**

Fort McMurray, Alberta,
Canada

Benthic invertebrate component lead for the Oil Sands Regional Aquatic Monitoring Program from 1997 to 2003; contributed to design of benthic invertebrate surveys, analyzed the data generated and prepared corresponding annual and 5-year report sections; prepared a summary of historical benthic invertebrate data for the Fort McMurray Oil Sands Region and compiled all available benthic invertebrate data collected from the 1970s to 2002.

**Shell Muskeg River
Mine EIA**

Fort McMurray, Alberta,
Canada

Writing team member for water quality and aquatic resources components; participated in baseline studies; assisted with preparation of supplemental responses for aquatic resources and water quality components.

**Suncor Project
Millennium EIA**

Fort McMurray, Alberta,
Canada

Writing team member for water quality and aquatic resources components; participated in baseline studies; carried out aquatic follow-up studies; assisted with preparation of supplemental responses for aquatic resources and water quality components.

**Synchrude Upgrader
EIA**

Fort McMurray, Alberta,
Canada

Prepared aquatic resources component of EIA.

**Shell Muskeg River
Bridge Crossing EIA**

Fort McMurray, Alberta,
Canada

Primary author of the EIA.

**Shell Jackpine Mine
EIA**

Fort McMurray, Alberta,
Canada

Writing team member for water quality and aquatic resources components; participated in baseline studies; carried out aquatic follow-up studies; assisted with preparation of supplemental responses for aquatic resources and water quality components.

**CNRL Horizon Project
EIA**

Fort McMurray, Alberta,
Canada

Writing team member for water quality and aquatic resources components; participated in baseline studies; carried out aquatic follow-up studies; assisted with preparation of supplemental responses for aquatic resources and water quality components.



TrueNorth Fort Hills Oil Sands Project EIA

Fort McMurray, Alberta, Canada

Writing team member for water quality and aquatic resources components; participated in baseline studies; carried out aquatic follow-up studies; assisted with preparation of supplemental responses for aquatic resources and water quality components.

OPTI Long Lake Project EIA

South of Fort McMurray, Alberta, Canada

Water quality component manager; primary author of water quality assessment; writing team member for aquatic resources component; participated in baseline studies; carried out aquatic follow-up studies; assisted with preparation of supplemental responses for aquatic resources and water quality components.

Rio Alto Kirby Project EIA

South of Fort McMurray, Alberta, Canada

Water quality component manager; primary author of water quality assessment; writing team member for aquatic resources component; participated in baseline studies; carried out aquatic follow-up studies; assisted with preparation of supplemental responses for aquatic resources and water quality components.

Petro-Canada Meadow Creek Project EIA

South of Fort McMurray, Alberta, Canada

Water quality component manager; primary author of water quality assessment; writing team member for aquatic resources and air emission effects components; participated in baseline studies; carried out aquatic follow-up studies; assisted with preparation of supplemental responses for aquatic resources and water quality components.

IORL Kearnl Project EIA

Fort McMurray, Alberta, Canada

Conducted a baseline benthic invertebrate study in selected streams in the Kearnl Oil Sands Project area; responsibilities included project management, data analysis and preparation of technical report on the status of the benthic invertebrate community. Contributed to preparation of fisheries and water quality sections of the impact assessment.

Syncrude Aurora Mine Baseline Study

Fort McMurray, Alberta, Canada

Conducted a baseline benthic invertebrate study in selected streams in the Syncrude Aurora South Mine area; responsibilities included project management, data analysis and preparation of technical report on the status of the benthic invertebrate community.

Acid Sensitivity Mapping of Soils and Lakes in the Oil Sands Region

Fort McMurray, Alberta, Canada

Project manager for completion of three reports summarizing acid sensitivity and critical load exceedances in the Oil Sands Region.

Suncor Voyageur Project EIA

Fort McMurray, Alberta, Canada

Writing team member for aquatic resources and air emission effects components; participated in baseline studies and preparation of impact assessment.

Shell Muskeg River Mine Expansion Project EIA

Fort McMurray, Alberta, Canada

Writing team member for aquatic resources and air emission effects components; participated in baseline studies and preparation of impact assessment.



MEG Energy Christina Lake Regional Project EIA

South of Fort McMurray,
Alberta, Canada

Water quality component manager; technical reviewer of water quality baseline and assessment, and air emission effects assessment; writing team member for aquatic resources component; participated in baseline studies.

PROJECT EXPERIENCE – OIL & GAS

North Saskatchewan River Water Quality and Benthic Invertebrate Monitoring

Edmonton, Alberta,
Canada

Water Quality and benthic invertebrate monitoring in the North Saskatchewan River in relation to municipal and industrial effluent inputs. Responsible for water quality, sediment and porewater sampling, and all aspects of benthic invertebrate monitoring, including development of sampling methods, field sampling, invertebrate taxonomy, data management, data analysis and interpretation, reporting and QA/QC.

Red Deer River Benthic Monitoring Below Condensate Spill

Caroline, Alberta,
Canada

Field work, data analysis and interpretation, and preparation of technical report on the impact of a hydrocarbon spill in the Red Deer River on the benthic invertebrate community.

Biological Baseline Investigations in the Moose Mountain Area

Kananaskis Country,
Alberta, Canada

Analysis and interpretation of benthic invertebrate data from streams near Moose Mountain as part of a biological baseline investigation.

Water Quality Monitoring of Six Lakes in the Vicinity of a Gas Plant

Caroline, Alberta,
Canada

Water quality monitoring, including field sampling, data analysis and preparation of technical report, to evaluate the presence or absence and severity of long-term effects of emissions from a sour gas processing plant on the water quality of six natural lakes located at various distances from the plant site.

Benthic Invertebrate Monitoring of the North Saskatchewan River

Edmonton, Alberta,
Canada

Conducted a benthic invertebrate study of the North Saskatchewan River near Redwater, Alberta, to evaluate the biological effect of a brine plume in groundwater under the river channel; responsibilities included project management, participation in meetings with regulators, study design, data analysis and preparation of technical report.

Evaluation of Algal Bloom in Fisherman Lake

Northwest Territories,
Canada

Project manager for a water quality study of Fisherman Lake to evaluate the potential causes of an algal bloom observed by local residents.

Evaluation of the Effect of Oil Well Outflow on Benthic Invertebrates

Peace River, Alberta,
Canada

Participated in a study of the effect of oil well outflow (groundwater) on benthic invertebrates in the Peace River; responsibilities included participation in meetings with regulators, study design, data analysis and contribution to technical report.



**Shell Castle River
Project Environmental
Assessment**
Peace River, Alberta,
Canada

Water quality component lead; technical reviewer of water quality baseline and assessment.

PROJECT EXPERIENCE – MINING

**Benthic Invertebrate
Monitoring of Sheep
Creek - 1992, 1994 and
1996**
Grande Cache, Alberta,
Canada

Data analysis and preparation of technical report on the status of the benthic community in Sheep Creek in northwestern Alberta, and an investigation of the potential ecological impacts of a coal mine.

**Review of the Use of
Artificial Substrates to
Sample Benthic
Invertebrates**
Canada

Literature review on the use, advantages and disadvantages of artificial substrates to sample benthic invertebrates for the assessment of the environmental quality in freshwater habitats, with specific reference to the use of this technique as an environmental effects monitoring tool for the Canadian mining industry.

**Baseline Study and
Effects Monitoring for
Musselwhite Mine**
Northern Ontario,
Canada

Data analysis and preparation of technical report on the status of the benthic community in streams and lakes in the Paseminon River system in Northern Ontario. The baseline report included recommended study design for future monitoring based on power analysis. Subsequent effect monitoring was carried out to evaluate the effects of the mine's discharge on benthic invertebrates in the receiving lake and river.

**Baseline Study for
Diavik Diamond Mine**
Northwest Territories,
Canada

Field survey, data analysis and interpretation as part of the fisheries baseline program in support of an EIA for a planned diamond mine on Lac de Gras.

**Effects of Mine Wastes
in the Moira River**
Ontario, Canada

Data analysis and preparation of technical report on the effects of arsenic contamination in the sediments of the Moira River on benthic invertebrates.

**Senior
Review/Technical
Editing of a Series of
Technical Reports**
Northern Saskatchewan,
Canada

Senior review/technical editing (aquatic) of a series of Technical Information Documents describing aquatic and terrestrial baseline conditions and predicted effects of a uranium mine.

**Aquatic Effects
Monitoring, Diavik
Diamond Mine**
Northwest Territories,
Canada

Benthic invertebrate component lead for the 2007 annual AEMP report; statistical analysis of data collected in 2007 as well as analysis of trends over time; preparation of technical report. Senior reviewer for water quality, plankton and benthic invertebrate sections of 2008 to 2011 annual AEMP reports, and water quality section of 2012 annual report. Attended regulatory meetings associated with AEMP renewal.



**Aquatic Effects
Monitoring, De Beers
Snap Lake Diamond
Mine**
Northwest Territories,
Canada

Senior technical reviewer for the 2007 annual report, which included water quality, sediment quality, plankton, benthic invertebrates and plume characterization to evaluate effects of a diamond mine on the aquatic ecosystem of a northern lake. Analysis of effects included statistical analysis of data collected in 2007 as well as analysis of trends over time in water quality and biological monitoring endpoints. Senior reviewer for water quality, plankton and benthic invertebrate sections of 2008 to 2011 annual AEMP reports, and benthic invertebrate section of 2012 annual report. Attended regulatory meetings associated with AEMP renewal.

**Baseline Studies and
Environmental
Assessment for De
Beers Gahcho Kue
Diamond Mine**
Northwest Territories,
Canada

Study design and senior oversight and review of lower trophic baseline studies; attendance of regulatory meetings associated with Aquatic Effects Monitoring Program development.

PROJECT EXPERIENCE – URBAN DEVELOPMENT

**Hidden Valley Lake
Aquatic Plant and
Water Quality
Monitoring**
Calgary, Alberta,
Canada

Monitoring of water quality and aquatic plant biomass during the summer months, and before and after lime/alum treatment in a stormwater retention pond in northern Calgary, including field work, data analysis and preparation of technical report.

**Chestermere Lake
Aquatic Plant Survey**
Calgary, Alberta,
Canada

Data interpretation and preparation of technical report during an assessment of aquatic plant biomass and sediment deposition rates in Chestermere Lake to document temporal trends in plant production and sediment deposition and to evaluate the effectiveness of mitigative measures to reduce nuisance aquatic plant growth.

**Water Quality
Assessment of a
Proposed Residential
Stormcanal System**
Airdrie, Alberta, Canada

Assessment of projected water quality, and evaluation of design and maintenance options for a canal system receiving urban and rural runoff in a proposed residential development, with the aim of achieving the best possible water quality in the system.

PROJECT EXPERIENCE – UTILITIES & LINEAR DEVELOPMENT

**Benthic Invertebrate
and Water Quality
Monitoring of the
Oldman River Below
the Oldman Dam**
Southern Alberta,
Canada

Analysis and interpretation of benthic invertebrate and water quality data collected by Alberta Environmental Protection to assess the ecological effects of operation of the Oldman Dam on the Oldman River.



Lower Kananaskis Lake Productivity Assessment

Kananaskis Country, Alberta, Canada

Field work, data analysis and interpretation, and preparation of technical report on the existing productivity of Lower Kananaskis Lake in relation to water level fluctuation due to hydropower production. Preparation of literature review on the effects of water level fluctuation on lake productivity and mitigative measures to ameliorate such effects.

Lake Minnewanka Study - Assessment of Water Level Fluctuation on Benthic Invertebrates

Banff National Park, Alberta, Canada

Field study design, data analysis and interpretation, and preparation of technical report on the effects of water level fluctuation on benthic invertebrates in Lake Minnewanka, a hydroelectric reservoir in Banff National Park, as part of a larger study to investigate the effects of reservoir operation on fisheries resources and to develop an ecologically-based reservoir management strategy.

Upper Kananaskis and Barrier Lake Productivity Assessment

Kananaskis Country, Alberta, Canada

Field study design, data analysis and interpretation, and preparation of technical report on the existing level of productivity in these lakes and the potential for the use of fertilization to enhance lake productivity.

Effect of Dam Leakage Test on River Biota

Abraham Lake, Alberta, Canada

Field study design, data analysis and interpretation, and preparation of technical report on the biological effects of nearly complete dewatering of a several km long reach of the North Saskatchewan River.

Wabamun Lake Study

Alberta, Canada

Field study design, field sampling, data analysis and interpretation of results for an assessment of the effect of a thermal discharge on aquatic plants in Lake Wabamun, near Edmonton. In addition, the effect of changes in water level on aquatic plant cover was also evaluated based on historical data and lake morphometry.

TransAlta Centennial Project EIA

Alberta, , Canada

Water quality component manager; primary author of water quality assessment; writing team member for aquatic resources component; participated in baseline studies; assisted with preparation of supplemental responses for aquatic resources and water quality components.

Mackenzie Gas Project

Northwest Territories, Canada

Water quality team member; contributed to baseline report, Environmental Impact Statement and various related reports and communications. Assisted with development of assessment approach. Water quality component lead from 2005.

PROJECT EXPERIENCE – RISK ASSESSMENT

Canada Creosote Ecological Impact and Risk Assessment

Calgary, Alberta, Canada

Benthic invertebrate studies to delineate zones of impacted benthic invertebrate communities in the Bow River as the result of creosote contamination, and gathering field data for an ecological risk assessment. Responsibilities included field work, invertebrate taxonomy, compilation and interpretation of data regarding the extent of creosote contamination of sediment and porewater, toxicity to fish and invertebrates, integration of data for the ecological risk assessment and report preparation.



**Crab Orchard
Ecological Risk
Assessment**
Marion, USA

Site visit to assess aquatic habitats, review of existing information, participation in study design and coordination of field sampling during an ecological risk assessment in Crab Orchard National Wildlife Refuge.

Wabamun Lake Study
Alberta, Canada

Ecological risk assessment of the effects of electric power plants on various components of the aquatic ecosystem of Wabamun Lake. Conducted a literature review on aquatic plants, performed analysis of historical plant data and prepared section of the report on submerged aquatic plants.

**Ecological Risk
Assessment in the
Trail, B.C., Area**
Trail, British Columbia,
Canada

Risk-based assessment of the effects of a smelter on the aquatic and terrestrial ecosystems; assisted with analysis of terrestrial vegetation data to evaluate the effects of aerial deposition of metals; designed and carried out a phased benthic invertebrate survey of the Columbia River to evaluate the aquatic biological effects of waste discharges and air emissions from the smelter.

**Ecological Risk
Assessment of
Tailings Dike Seepage**
Fort McMurray, Alberta,
Canada

Risk-based assessment of the effects of seepage from a tailings dike on the aquatic ecosystem; designed and carried out a benthic invertebrate survey of the receiving stream to evaluate the aquatic biological effects of seepage waters to support selection of appropriate mitigation.

PROJECT EXPERIENCE – INDUSTRY

**North Saskatchewan
River Water Quality
and Benthic
Invertebrate
Monitoring**
Edmonton, Alberta

Benthic invertebrate and water quality monitoring in the North Saskatchewan River in relation to municipal and industrial effluent inputs. Responsible for water quality, sediment and porewater sampling, and all aspects of benthic invertebrate monitoring, including development of sampling methods, field sampling, invertebrate taxonomy, data management, data analysis and interpretation, reporting and QA/QC.

**Benthic Monitoring of
the North
Saskatchewan River
Near a Groundwater
Ammonia Plume**
Edmonton, Alberta

Study design, field work, data analysis and interpretation, and preparation of technical report as part of a multidisciplinary investigation of the ecological effects of an ammonia plume in groundwater in the North Saskatchewan River.

**Red Deer River Benthic
Invertebrate and Water
Quality Monitoring,
1993 – 2003**
Red Deer, Alberta,
Canada

Field work, data analysis and preparation of technical report on the status of the benthic invertebrate community and the potential effects of the effluents from two chemical processing plants on the benthic invertebrate community and water quality in the Red Deer River.

**Benthic Invertebrate
Monitoring of the
South Saskatchewan
River**
Medicine Hat, Alberta,
Canada

Field work, data analysis and preparation of technical report on the status of the benthic invertebrate community and the potential effects of the effluents from a fertilizer manufacturing plant on the benthic invertebrate community and water quality in the South Saskatchewan River.



EIAs for Chemical Processing Plants
Red Deer, Alberta,
Canada

Reviewed historical benthic invertebrate and water quality data and prepared part of the aquatic baseline report for two EIAs.

Benthic Invertebrate Monitoring of the North Saskatchewan River
Medicine Hat, Alberta,
Canada

Field work, data analysis and preparation of technical report on the status of the benthic invertebrate community and the potential effects of a groundwater brine plume on the benthic invertebrate community and water quality in the South Saskatchewan River (1997). Project manager and senior technical reviewer of a 2006 follow-up study at the same location.

PROJECT EXPERIENCE – MUNICIPALITIES

North Saskatchewan River Water Quality and Benthic Invertebrate Monitoring
Edmonton, Alberta,
Canada

Benthic invertebrate and water quality monitoring in the North Saskatchewan River in relation to municipal and industrial effluent inputs. Responsible for water quality, sediment and porewater sampling, and all aspects of benthic invertebrate monitoring, including development of sampling methods, field sampling, invertebrate taxonomy, data management, data analysis and interpretation, reporting and QA/QC.

North Saskatchewan River - Benthic Invertebrate Monitoring Near City of Edmonton Landfills
Edmonton, Alberta,
Canada

Data analysis and interpretation, and preparation of technical report on the potential effects of leachate from two municipal landfills on the benthic invertebrate community of the North Saskatchewan River.

Bow - Benthic Invertebrate Monitoring, Upstream and Downstream of Calgary
Calgary, Alberta,
Canada

Field site selection, data analysis and interpretation, and preparation of technical report on the potential combined effects of discharges from the City of Calgary on the benthic invertebrate community of the Bow River.

PROJECT EXPERIENCE – ENVIRONMENTAL EFFECTS MONITORING

Review of the Use of Artificial Substrates to Sample Benthic Invertebrates
Canada

Literature review of the use, advantages and disadvantages of artificial substrates to sample benthic invertebrates for the assessment of the environmental quality in freshwater habitats, with specific reference to the use of this technique as an environmental effects monitoring tool for the Canadian mining industry.



**Environmental Effects
Monitoring for
Weyerhaeuser
Canada’s Prince Albert
Facility**
Prince Albert,
Saskatchewan, Canada

Data analysis and interpretation, and preparation of technical report on the effects of pulp mill effluent on benthic invertebrate communities of the North Saskatchewan River, to fulfill federal Environmental Effects Monitoring requirements.

**Environmental Effects
Monitoring for
Weyerhaeuser
Canada’s Grande
Prairie Facility**
Grande Prairie, Alberta,
Canada

Data summary and interpretation, and preparation of a summary report on the effects of pulp mill effluent on benthic invertebrate communities of the North Saskatchewan River, to fulfill federal Environmental Effects Monitoring requirements. Field sampling, data analysis and report preparation for the Cycle 2 invertebrate community survey, and data analysis and report preparation for the Cycle 3 invertebrate community survey.

**Environmental Effects
Monitoring for
Weldwood of Canada’s
Hinton Facility**
Hinton, Alberta, Canada

Field sampling, data analysis, interpretation of results and report preparation for the Cycle 2 and 3 EEM invertebrate community surveys.

**Environmental Effects
Monitoring for Slave
Lake Pulp**
Slave Lake, Alberta,
Canada

Field sampling, data analysis, interpretation of results and report preparation for the Cycle 3 EEM invertebrate community survey.

**Environmental Effects
Monitoring for Giant
Mine**
Northwest Territories,
Canada

Senior review of benthic invertebrate components of the Phase 1 and Phase 2 EEM invertebrate community survey reports.

**Environmental Effects
Monitoring for Con
Mine**
Northwest Territories,
Canada

Senior review of benthic invertebrate components of the Phase 1 and Phase 2 EEM invertebrate community survey reports.

**Environmental Effects
Monitoring for Con
Mine**
Northwest Territories,
Canada

Senior review of benthic invertebrate components of the Phase 1 and Phase 2 EEM invertebrate community survey reports.

PROJECT EXPERIENCE – INSTREAM FLOW NEEDS (IFN)

**Instream Flow Needs
Scoping for the
Athabasca River**
Alberta, Canada

Reviewed historical water quality and benthic invertebrate data, and prepared data summary and recommendations for further work to support the IFN process.



Instream Flow Needs Scoping for the Lesser Slave River
Alberta, Canada

Reviewed historical water quality and benthic invertebrate data, and prepared data summary and recommendations for further work to support the IFN process.

Instream Flow Needs Scoping for the Sturgeon River
Alberta, Canada

Reviewed historical water quality and benthic invertebrate data, and prepared data summary and recommendations for further work to support the IFN process.

PROFESSIONAL AFFILIATIONS

Member, Canadian Society of Environmental Biologists

Member, North American Benthological Society

PUBLICATIONS

Conference Proceedings

Kovats, Z.E., J.J.H. Ciborowski and S. Pernal. 1987. *Biomonitoring Protocols for Adult Aquatic Insects: Collection Procedures, Seasonal Variation and Dispersal*. 1987 Technology Transfer Conference. Toronto, Ontario, Canada.

Kovats, Z.E. and J.J.H. Ciborowski. 1988. *Biomonitoring Protocols for Adult Aquatic Insects: Contaminant Trends, Sample Size and Sensitivity*. 1988 Technology Transfer Conference. Toronto, Ontario, Canada.

Kovats, Z.E. and J.J.H. Ciborowski. 1989. *Organochlorine Contaminant Burdens of Adult Aquatic Insects Collected from Great Lakes Connecting Channels*. 1989 Technology Transfer Conference. Toronto, Ontario, Canada.

Fraikin, C.G., B.K. Firth, Z.E. Kovats, C.P. Bjornson, T.L. Dirks, R.D. Robinson, G.M. Wilson, T.I. Tones and S.M. Swanson. 2003. *Employing Small bodied Fish in a Weight-of-Evidence Approach to Discriminate Effects from Multiple Discharges*. Pulp & Paper Mill Effluent Environmental Fate & Effects, Fifth International Conference on Fate and Effects of Pulp and Paper Mill Effluents, June. Seattle Washington, US.

Kovats, Z.E., D. Jobson and L. Dunning. 2004. *Use of Historical Benthic Invertebrate Data to Define the Reference Condition for Monitoring An Industrial Discharge*. 52nd Annual Meeting of the North American Benthological Society, June. Vancouver B.C., Canada.

Dunnigan, M., P. McEachern, L. Noton and Z.E. Kovats. 2004. *Effects of Oxygen Depletion on Benthic Macroinvertebrates in an Ice-covered River*. 52nd Annual Meeting of the North American Benthological Society, June. Vancouver B.C., Canada.

Other

Kovats, Z.E., and J.J.H. Ciborowski. 1989. Aquatic Insect Adults as Indicators of Organochlorine Contamination. *J. Great Lakes Res.* 15:623-634.



Kovats, Z.E. 1992. 1990/91 Great Lakes - St. Lawrence Research Inventory. Council of Great Lakes Research Managers, International Joint Commission. Report to the International Joint Commission, Windsor, Ontario.

Kovats, Z.E. (Co author) 1991. 1991 Report to the International Joint Commission. Chapter 9 - Wetlands and Heritage Protection. Great Lakes Science Advisory Board. International Joint Commission, Great Lakes Regional Office, Windsor, Ontario.

Kovats, Z.E., and J.J.H. Ciborowski. 1992. Organochlorine Contaminant Concentrations in Caddisfly Adults (Trichoptera) Collected from Great Lakes Connecting Channels. *Environ. Mon. & Assess.* 27:135-158.

Kovats, Z.E., L.D. Corkum and J.J.H. Ciborowski. 1995. Aquatic Insects as Biomonitors of Ecosystem Health in the Great Lakes Areas of Concern. In Butterworth, F. (Editor), *Biomonitoring and biomarkers as indicators of environmental change*. Plenum Press, New York.

Kovats, Z.E., J.J.H. Ciborowski, and L.D. Corkum. 1996. Inland Dispersal of Adult Aquatic Insects. *Freshwater Biology.* 36: 265-276.

Kovats, Z.E., J.J.H. Ciborowski and L.D. Corkum. 2000. *Biomonitoring Protocols for Adult Aquatic Insects*. Final Rep. to Research Advisory Committee, Ontario Ministry of the Environment.



Education

M.Sc. Biology, York University, North York, Ontario, 1994

B.Sc. Biology, Honours, McMaster University, Hamilton, Ontario, 1991

Golder Associates Ltd.

Kristine is a project manager/director and senior fisheries biologist with more than 18 years of experience in aquatic and fisheries biology. She has field and office-based experience with a wide variety of projects in Alberta, British Columbia and the Northwest Territories, including fisheries inventory and impact assessment for development projects, such as oil and gas, mining, seismic operations, linear developments and hydroelectric facilities. She has experience in the assessment and mitigation of impacts from a variety of development projects on fish, fish habitat and the aquatic ecosystem. As well as dealing with the scientific and technical aspects of these types of developments, Kristine has also been involved with the regulatory approval process under the Fisheries Act and the Alberta Codes of Practice for crossings under the Water Act.

Kristine has managed/directed the fisheries components for several large environmental impact assessment projects. Kristine managed the Fish and Fish Habitat component for the De Beers Gahcho Kué Project in the Northwest Territories and is the component director for the Dominion Diamond Jay Project. In the Oil Sands Region in Northern Alberta, Kristine managed the Fish and Fish Habitat components for Shell's Jackpine Mine Expansion & Pierre River Mine Project, Suncor's Voyageur South Project and MEG Energy's Christina Lake Regional Project, among others. Kristine was also involved in impact assessment, permit approvals and hearing preparation/support for the fish and fish habitat component of the Mackenzie Gas Project.

Kristine has also been the Project Manager/Director for environmental assessment of Oil Sands Projects in Northern Alberta.

Employment History

Golder Associates Ltd. – Calgary, Alberta

Associate. Senior Fisheries Biologist/Project Manager (2000 to Present)

Responsible for managing projects/tasks related to environmental impact assessment, impact mitigation and management, and monitoring of proposed oil, gas and mining developments in western and northern Canada. Also responsible for senior technical advice, proposal preparation, project management, field sampling, data analysis, impact assessment, client liaison, report writing and regulatory consultation.

Aquatics Division Manager (2008 to 2009)

Division manager responsible for about 40 professionals in the fields of fisheries and water quality as well as support staff. The role includes the participation in the office management team, supervision of group manager's activities, financial analysis and reporting, recruiting and personnel management, as well as contribution to strategic decisions within the Division.



Fisheries Group Manager (2006 to 2008)

Group manager responsible for about 20 professionals (fisheries biologists and technicians). Responsibilities included scheduling and management of staff, workload allocation, recruitment, budgeting, and financial management.

Triton Environmental Consultants Ltd. – British Columbia, Canada
Biologist/Project Manager (1996 to 1999)

Biologist for watershed inventory, fish habitat assessment and impact assessment projects. Field and office experience with a wide variety of environmental projects, including Forest Renewal BC funded lake and stream inventory, stream classification according to the Forest Practices Code and watershed restoration program. Involved with background review, data analysis and interpretation, and report writing for environmental impact assessments for large-scale industrial and mining projects. Responsible for proposal preparation, client liaison and budget tracking for selected projects. Supervised field crews in remote locations and delegated responsibility for planning and post-field data analyses. Coordinated data collection, entry and analysis and report preparation.

Ontario Ministry of Natural Resources – Maple, Ontario
Community Dynamics Biologist (1995 to 1995)

Statistical analyses and report writing, focusing on salmonid/invertebrate interactions.

York University, Biology Department – North York, Ontario
Research Assistant / Teaching Assistant (1992 to 1994)

Limnological assessment including sampling for crayfish, benthic invertebrates, zooplankton and aquatic plants in Lake Simcoe, Ontario. Performed laboratory experiments of crayfish respiration and crayfish predation on salmonid embryos. Modelled effects of crayfish predation rates on the lake trout population of Lake Simcoe. Maintained salmonid embryos and adult crayfish in a wet laboratory. Laboratory assistant for undergraduate courses in Comparative Vertebrate Anatomy, Biology of Animals, Ichthyology and Natural Science.

Ontario Ministry of Natural Resources – Maple, Ontario
Fisheries Resource Technician (1992 to 1993)

Limnological, invertebrate and fish sampling. Performed measurements of crayfish distribution and calculated estimates of density.



PROJECT EXPERIENCE – ENVIRONMENTAL IMPACT ASSESSMENT

- De Beers Canada Inc.
Gahcho Kué Project**
Northwest Territories
- Managed the fish and fish habitat component for the environmental impact statement for the project. Responsible for EIS report preparation, responses to Information Requests, attending regulatory/technical meetings, and development of the Aquatic Effects Monitoring Program. Also involved in providing regulatory support and advice, offsetting planning, and Health and Safety.
- Dominion Diamond
Jay Project**
Northwest Territories
- Fish and fish habitat component director and aquatics technical director for the proposed Jay Project. Responsible for EA preparation for aquatics components, including fish and fish habitat.
- Cenovus Energy
Pelican Lake Grand
Rapids Project**
Wabasca, Alberta
- Project Manager for the environmental impact assessment for the Cenovus Pelican Lake Grand Rapids project. Responsible for scheduling, Health and Safety, cost tracking, quality control, report review, client liaison and regulatory advice.
- Cenovus Energy
Pelican Lake Grand
Rapids Pre-
Disturbance
Assessment**
Wabasca, Alberta
- Project Director for the pre-disturbance assessment for the Cenovus Pelican Lake Grand Rapids project.
- Shell Canada Jackpine
Mine Expansion &
Pierre River Mine
Project**
Fort McMurray, Alberta
- Managed the environmental impact assessment for the fish and fish habitat component of the project. Involved in the development of the Conceptual Compensation Plan to meet the requirement for No Net Loss of productive capacity of fish habitat, as well as follow-up work related to the project.
- ConocoPhillips,
Surmont Expansion
Project**
Conklin, Alberta
- Responsible for providing senior advice and direction to fish and fish habitat component lead on the completion of baseline studies and report preparation.
- MEG Energy, Christina
Lake Regional Project
Phase 2**
Conklin, Alberta
- Managed the completion of baseline studies and an environmental impact assessment as the fish and fish habitat component lead for the Phase 2 of the MEG Energy Christina Lake Regional Project. Involved in the preparation of responses to Supplemental Information Requests and Statements of Concern.
- Suncor Energy,
Voyageur South
Project**
Fort McMurray, Alberta
- As the fish and fish habitat component lead, managed the completion of baseline studies and an environmental impact assessment for the Suncor Voyageur oil sands development in the Poplar Creek and Beaver River watersheds north of Fort McMurray.



- Mackenzie Gas Project**
Northwest Territories,
Canada
- Involved in task management, impact assessment, field planning and report preparation for the fish and fish habitat component of the Mackenzie Gas Project. Participated in the preparation of the Environmental Impact Statement and responding to Information Requests. Involved in permit approval process and hearing preparation/support. The project involves the development of the natural gas reserves in the Mackenzie River Delta and construction of a pipeline and associated infrastructure from the production fields down the Mackenzie River valley to Alberta.
- AXYS Environmental,
ConocoPhillips
Surmont Phase 2**
Fort McMurray, Alberta
- Managed the Fisheries component involving an update to the project description for the ConocoPhillips Surmont EIA.
- MEG Energy, Christina
Lake Regional Project**
Conklin, Alberta
- Managed the completion of baseline studies and an environmental impact assessment as the aquatic resources component lead for the MEG Energy Christina Lake Regional Project located near Conklin, Alberta.
- Sunshine Village
Corporation, Healy
Creek**
Banff, Alberta
- Fish and fish habitat task manager for an environmental assessment for water withdrawal from Healy Creek for snowmaking operations at Sunshine Village in Banff National Park. Co-ordinated baseline fish and fish habitat field studies, data compilation and report preparation. Involved in regulatory liaison and providing technical advice to Sunshine.
- OPTI/Nexen, South
Lease Baseline Project**
Conklin, Alberta
- Managed the completion of field studies as fish and fish habitat discipline lead for the OPTI/Nexen South Lease baseline studies, as a proposed expansion to the Long Lake Project.
- PetroCanada, Meadow
Creek II Project**
Fort McMurray, Alberta
- Managed the completion of baseline studies as fish and fish habitat discipline lead for a proposed expansion to the PetroCanada Meadow Creek Project.
- Rio Alto Exploration
(now Canadian
Natural), Kirby Project**
Conklin, Alberta
- As the aquatic resources component lead, managed and participated in baseline aquatic studies and the completion of the environmental impact assessment for Rio Alto Exploration Ltd.'s (now Canadian Natural) Kirby SAGD development near Conklin, Alberta.
- TransAlta Utilities,
Keephills EIA**
Keephills, Alberta
- Collected water and sediment quality samples and water quality measurements within the power plant cooling pond and other local waterbodies to provide baseline data for the impact assessment.
- True North (now UTS),
Fort Hills Project**
Fort McMurray, Alberta
- Collected baseline inventory data in lake and stream habitats for a proposed oil sands development in the Fort McMurray area. Field studies included the collection of water quality, habitat mapping, discharge and fish inventory data.
- Taseko Mines,
Prosperity Project
Williams Lake,
British Columbia**
Williams Lake, British
Columbia
- Data analyses and impact assessment reporting for water quality data collected for the proposed Prosperity Gold-Copper project near Williams Lake, BC.



PROJECT EXPERIENCE – LINEAR DEVELOPMENTS

- Mackenzie Gas Project**
Northwest Territories,
Canada
- Involved in task management, impact assessment, field planning and report preparation for the fish and fish habitat component of the Mackenzie Gas Project. Participated in the preparation of the Environmental Impact Statement and responding to Information Requests. Involved in permit approval process and hearing preparation/support.
- Parks Canada,
TransCanada Highway
Twinning, Phase IIIB**
Banff, Alberta
- Managed completion of the fish and fish habitat component of the environmental screening for the proposed twinning of Phase IIIB of the TransCanada Highway in Banff National Park, including the collection of baseline field data at proposed watercourse crossings. The screening was required to meet requirements of the Canadian Environmental Assessment Act.
- OPTI/Nexen,
Watercourse
Crossings**
Anzac, Alberta
- Managed fish and fish habitat studies for pipeline and watercourse crossings in the Long Lake and Jackfish leases. Provided technical advice to OPTI/Nexen related to provincial and federal authorization requirements for their linear infrastructure and prepared applications and supplementary reports to Fisheries and Oceans for the proposed crossings.
- Paramount Resources,
Pipeline Crossings**
Northern Alberta
- Managed studies to assess fish and fish habitat at proposed pipeline watercourse crossings associated with numerous gathering systems (e.g., Dover, Goose, Shadow, Mirage, Little Smoky and Valhalla) and prepared necessary documents for authorization of works by provincial and federal authorities.
- Alaska Gas Producers
Pipeline Team,
Feasibility Study**
Calgary, Alberta
- Involved in the fish and fish habitat investigation along three pipeline routes proposed by a consortium of Alaskan North Slope Gas producers. Baseline studies included reconnaissance level surveys of fish habitat along the proposed pipeline routes.
- CN Rail, Fish Habitat
Assessments**
Northern British
Columbia, Canada
- Fish habitat assessment of streams crossing the rail line between Houston and Prince Rupert, BC.

PROJECT EXPERIENCE – SEISMIC OPERATIONS

- Aguila, Winter Seismic
Monitoring**
Mackenzie Delta,
Northwest Territories
- Provided senior advice on an aquatic monitoring project for Aguila's winter seismic program in the Mackenzie Delta.
- Chevron Canada
Resources, Winter
Seismic Monitoring**
Mackenzie Delta,
Northwest Territories
- Managed aquatic monitoring projects at ChevronTexaco's winter seismic programs in the Mackenzie Delta, which involved field coordination, client liaison, data analyses and report preparation.



DeBeers, Air Gun Seismic
Yellowknife, Northwest Territories

Provided technical expertise to the team involved in the preparation of a project description for a proposed air gun seismic operation in Snap Lake.

WesternGeco, Winter Seismic Monitoring
Mackenzie Delta, Northwest Territories

Project manager for environmental monitoring of winter seismic programs conducted in the Mackenzie Delta at the WesternGeco Parsons Lake, Nuna and Tittlalik seismic programs. Responsibilities included field coordination, sampling, client and regulatory liaison, data analyses and report preparation. Field studies monitored water quality during drilling operations and blast induced water overpressures during blasting. Data was collected according to protocols established by Fisheries and Oceans Canada (Western Arctic area).

Salmo Consulting, Monitoring Data Review
Calgary, Alberta

Project manager for project to perform data analyses of water quality and overpressure monitoring data collected in the Mackenzie Delta during the winter of 2002. Data from multiple programs and program areas were compiled, analyzed, and summarized, in a written report, which was incorporated into a background paper on the Use of Explosives in Waterbodies for the Canadian Association of Petroleum Producers (CAPP).

Salmo Consulting, Fish Deterrent Review
Calgary, Alberta

Involved in the review of fish deterrent literature and the applicability for seismic operations. A summary of the information was produced, as well as a simple study design and cost estimate for testing of potential deterrents.

Gulf Canada Resources, Seismic Monitoring
Parsons Lake, Northwest Territories

Monitoring of summer seismic activities in Parsons Lake, NWT, including blast-induced overpressure monitoring, turbidity monitoring, and water and sediment quality sampling. A report was prepared summarizing the results of the monitoring.

PROJECT EXPERIENCE – AQUATIC STUDIES

Fisheries and Ocean Canada, Pathways of Effects
Calgary, Alberta

Managed project to conduct a literature review to provide scientific evidence for the linkages between certain physical activities and the endpoints of temperature and dissolved oxygen, as part of DFO’s “Pathways of Effects” methodology. This involved identification of linkages, database searches, selection of relevant literature and summarizing into a report.

City of Calgary, Pine Creek Baseline
Calgary, Alberta

Fish and fish habitat component lead for the first phase of aquatic baseline studies of Pine Creek, a tributary to the Bow River south of Calgary. Developed study plan and coordinated field data collection.

Fisheries and Ocean Canada, Dredging Review
Inuvik, Northwest Territories

Managed project to conduct a literature review on the potential physical and biological effects of dredging in the Beaufort Sea. The results of the literature review were summarized, including the aquatic organisms present in the Beaufort Seas, past dredging operation, environmental effects of dredging, mitigation and recovery, and appropriate legislation and guidelines.



Petrobank, Coal Bed Methane Project
Princeton, British Columbia

Managed literature review and completion of baseline fish and fish habitat studies for a proposed coal bed methane project near Princeton, British Columbia. Seasonal studies were developed to meet the draft Code of Practice for coal bed methane operations.

Sunshine Village Corporation, Healy Creek
Banff, Alberta

Task manager for project to perform bank repair and restoration to Healy Creek at the Sunshine Village base area. Prior to construction, a site visit was conducted and reports prepared for Fisheries and Oceans and Parks Canada. At the time of construction further baseline fish habitat studies were conducted, as well as monitoring of suspended sediment during construction. A report was prepared for both regulatory agencies.

TransCanada Pipelines, Michel Creek
Calgary, Alberta

Prepared an assessment of the extent and significance of an inadvertent release of sediments into Michel Creek during construction of a dam and flume pipeline crossing. The assessment was requested by TCPL Legal counsel in anticipation of charges being laid under Section 36(3) of the Fisheries Act.

Cominco Mines, Risk Assessment
Trail, British Columbia

Preparation of a problem formulation report for a screening level risk assessment. Responsibilities included literature review and summary, analysis of data, and report preparation.

TransAlta Utilities, Weed Harvesting
Wabamun Lake, Alberta

Monitoring of weed harvesting program in Wabamun Lake, including field work and reporting. Performed fish salvage in the outlet canal of the Wabamun power plant.

Queen Charlotte Power
Moresby Island, British Columbia

Collected background fisheries and limnological information for proposed hydroelectric project near Takakia and Moresby Lakes, Queen Charlotte Islands.

PROJECT EXPERIENCE – FORESTRY

Slocan Group, Tolko Industries and Weldwood of Canada
Quesnel, British Columbia

Watershed inventory in various working areas within the Quesnel TSA. Field data collection involved fish sampling and biophysical characteristics. Responsible for field logistics, data collection, analyses and report writing.

Carrier Lumber
Prince George, British Columbia

Watershed inventory in the Missinka watershed. Responsible for lake inventory data collection and report writing.

Riverside Industries
Chilcotin, British Columbia

Reconnaissance level lake inventories of lakes in the Chilcotin region of British Columbia. Responsible for lake inventory data collection, report writing and budgeting.

Ministry of Environment, Lands and Parks
North Coast, British Columbia

Lake inventory of remote lakes on the North Coast of BC, involving bathymetric sounding, fish sampling, limnological and water sampling. Observed wildlife and identified aquatic and terrestrial plants. Responsible for budgeting, client liaison, field logistics, data collection, analyses and report writing.



**Ministry of Forests,
Kalum Forest District**
Terrace, British
Columbia

Stream Survey and Riparian Classification for streams in the Nass watershed. Supervised field crews performing classification of tributary streams according to the Forest Practices Code.

Skeena Sawmills
Terrace, British
Columbia

Classified fish streams, riparian management areas and wetlands in accordance to the Forest Practices Code in various watersheds on the North Coast of BC.

**International Forest
Products**
North Coast, British
Columbia

Inventory and classification of streams within the Kumealon Lake watershed on the North Coast of BC.

**International Forest
Products**
Porcher Island, British
Columbia

Involved with the report writing and editing for a large watershed restoration program report for watersheds on Porcher Island, BC.

PROFESSIONAL AFFILIATIONS

Member, Alberta Society of Professional Biologists (ASPB)



Education

B.Sc. Biology with Oceanography, University of Southampton, UK, 1995

Certifications

SFA and CPR, Yellowknife, 2010

NWT Mine Supervisor Level 1, Yellowknife, 2010

Languages

English – Fluent

Golder Associates Ltd.

Damian Panayi lives and works in the Northwest Territories. He was raised in the NWT and Nunavut, and considers this to be home. Damian's career began in wildlife studies, but since then his work has expanded to include environmental assessment, cumulative effects assessment, permitting, consultation, toxicological risk assessment, environmental baseline studies and environmental monitoring. Damian has recent experience with permitting and monitoring of hydroelectric, mining and mineral exploration projects. Damian has also been a project manager and lead field technician for several northern environmental baseline and monitoring programs, has designed and implemented wildlife monitoring plans, completed literature reviews, assisted with risk assessments, contaminated site assessments and gap analysis.

Damian is also experienced with many types of environmental field studies and monitoring, including muskox, caribou, wolverine, wolves, grizzly bears, songbirds, falcons and wildlife habitat. Other experience includes managing a research camp, conducting necropsies and meat inspections, assessment of wildlife body condition, collaring and aerial telemetry.

Employment History

Golder Associates Ltd. – Yellowknife, Northwest Territories

Wildlife Biologist (2000 to Present)

Recent experience with permitting and monitoring of hydroelectric, mining and mineral exploration projects. Project manager for several environmental monitoring programs and an environmental assessment. Assisted with several environmental assessments and cumulative impact assessments. Project managed and field technician at remote mine wildlife monitoring programs, lead reporting of the results. Developed wildlife monitoring plans. Delivered presentations to public and technical audiences. Assisted with community meetings. Development and delivery of environmental technician training courses. Conducted environmental site assessments. Assisted with toxicology risk assessments. Used GIS software to analyse and display data. Manage databases and coordinate field programs.

Department of Sustainable Development – Kugluktuk, Nunavut Territory

Wildlife Technician (1997 to 2000)

Worked closely with biologists, and local Hunter and Trapper Associations. Conducted environmental monitoring, assessed disease status of caribou and muskox through necropsies, managed wolverine carcass collection program, conducted aerial surveys and telemetry surveys, organized and managed remote research camps, collected and managed data, reported on results.

Department of Indian and Northern Affairs Canada – Yellowknife,



Northwest Territories

Technician (1996 to 1996)

Completed report on Granular Material Usage in the Northwest Territories. Set up database of Land Use Permits issued by Indian and Northern Affairs. Wrote a data entry program to facilitate database updates.

***Department of Resources, Wildlife & Economic Development –
Yellowknife, Northwest Territories***

Wildlife Technician (1996 to 1996)

Field assistant for several wildlife management research projects.

Rankin Inlet Peregrine Falcon Project – Rankin Inlet, Nunavut

Field Assistant (1992 to 1995)

Recorded behavioural observations of peregrine falcons, collected and prepared samples, banded and measured adults and chicks. Operated and maintained boat, snow machines and ATVs.



PROJECT EXPERIENCE – VARIOUS

- Snap Lake Mine**
Northwest Territories,
Canada
- Project Manager for environmental monitoring at the Snap Lake Mine.
- Thaidene Nene National Park**
Northwest Territories,
Canada
- Undertook a literature review and ecological values review for the Parks Canada Thaidene Nene (East Arm) National Park Proposal. Used advanced literature review methods using Golder's internal library resources to quickly search a wide range of sources.
- Database of Landscape Disturbance**
Northwest Territories,
Canada
- With assistance from the Cumulative Impact Monitoring Program, developed a database describing human activity and landscape disturbance in the North and South Slave, and Inuvialuit Settlement Regions of the Northwest Territories. This database can be used to provide a quantitative estimate of cumulative effects. The database brings together many different sources of information, such as land use permits, water licences, land leases, roads, transmission lines, parks, and communities. The database has since been used in the cumulative effects assessment of four recent projects in the NWT.
- NICO Project**
Northwest Territories,
Canada
- Conducted wildlife baseline surveys at an exploration property, and assisted with study design. Surveys have included aerial surveys for ungulates, raptors and waterfowl, and ground-based songbird, snow track and browse/pellet surveys. Reported on the results. Contributed to the environmental assessment, and participated in technical and public hearings. Prepared Wildlife Monitoring and Wildlife Habitat Protection Plans.
- Taltson Hydroelectric Expansion Project**
Northwest Territories,
Canada
- Internal project manager and technical lead for the environmental assessment of the proposed Taltson Hydroelectric Expansion Project. Worked with multi-consultant team to develop assessment methods and cumulative effects assessment approach. Managed internal team to conduct an assessment of incremental and cumulative effects to wildlife and land-users. Designed and implemented aerial survey studies to document baseline conditions along the proposed routes of a proposed transmission line. Conducted literature review regarding the possible impacts of a transmission line to wildlife.
- Effects of Human Activity to Caribou**
Nunavut, Canada
- With assistance from the Nunavut Wildlife Management Board and in partnership with the Kugluktuk Hunters and Trappers Organization, assisted with and managed an investigation into the effects of human development and activity to barren-ground caribou, using both Inuit traditional knowledge, and spatial analysis of collared caribou movements. A key goal was the integration of traditional knowledge and science.
- Lutsel Ke Mini Hydro**
Northwest Territories,
Canada
- Project manager and technical lead for the scoping of effects to the terrestrial environment for a proposed transmission line and run-of-river mini hydro development on the Snowdrift River.



- Gahcho Kue Project**
Northwest Territories,
Canada
Contributed to the environmental review document for the proposed Gahcho Kue diamond mine. Major contributions included a summary of the mine's cumulative effects, and preparation of Wildlife Monitoring and Wildlife Habitat Protection Plans.
- Discovery Mine**
Northwest Territories,
Canada
Completed a review of dozens of documents from many different disciplines to assess the success of closure and closure monitoring at the Discovery Mine site. The information was distilled into a single report discussing the success of monitoring activities to date at the Discovery Mine.
- Jericho Diamond Mine**
Nunavut Territory,
Canada
Developed and implemented a wildlife monitoring plan for the Jericho Diamond Mine, and worked with regulatory agencies to gain approval of the plan. Conducted wildlife monitoring and reported on results.
- Bluefish Hydroelectric**
Northwest Territories,
Canada
Assisted the Northwest Territories Power Corporation with the strategic advice for permitting, regulatory engagement, and acquisition of land use permit, water licence and Fisheries Act Authorization required to construct a new dam at the Bluefish hydroelectric facility. Also managed the preparation or update of eleven environmental monitoring plans, and assisted in gaining approval for these plans from the Mackenzie Valley Land and Water Board. Currently assisting NTPC with environmental monitoring and annual reporting, implementation of water flow and mercury monitoring plans required by the Water Licence and Fisheries Act Authorization.
- Behchoko Fish Monitoring Pilot Study**
Northwest Territories,
Canada
Assisted with a community-based fisheries monitoring program. Working with community youth and elders, three days of fish collections were conducted on Marian Lake and Great Slave Lake. Fish health and demographic information was collected to test the feasibility of a community-based monitoring program.
- Meliadine Gold Project**
Nunavut Territory,
Canada
Assisted with environmental assessment and completed a review of the existing wildlife information collected at the Meliadine Property, identified gaps, and designed a field program to fill gaps and update data. Assisted with field investigations.
- Hope Bay Gold Project**
Nunavut Territory,
Canada
Assisted with the development and implementation of a wildlife monitoring plan for the Doris North Project. Assisted with baseline environmental studies.
- Various contaminated sites**
Northwest Territories/Nunavut Territory, Canada
Assisted with Phase 1 and 2 Environmental Site Assessments of three exploration camps in the Kitikmeot region of the Nunavut Territory. Assisted with reporting on two environmental site assessments of two abandoned mines in the Great Bear Lake area, Northwest Territories. Conducted field investigations and assisted with the risk assessment of the abandoned Tundra Mine, Northwest Territories.
- Various Clients**
Northwest Territories,
Canada
Developed and delivered a two-day course entitled Environmental Monitoring Techniques. The course was developed to reduce the dependence on "on-the-job" training for environmental technicians working at various mine site, with the objective of assisting technicians to reduce bias in data collection. Course included module on monitoring theory, health and safety, wildlife, and water quality.



Snap Lake Diamond Mine
Northwest Territories,
Canada

Contributed to the environmental assessment of the Snap Lake Diamond Project, and field technician for the Snap Lake environmental monitoring program. Hired and trained aboriginal assistants, supervised and conducted wildlife surveys. Ensured permitting and health and safety standards were met. Set up and maintained databases. Presented results to public and technical audiences. Liaise with government biologists. Assisted with Snap Lake Wildlife Monitoring Report.

Ekati Diamond Mine
Northwest Territories,
Canada

Lead technician and author for the Ekati Wildlife Effects Monitoring Program, 2000 to 2003. Results from this monitoring program are submitted to the Independent Environmental Monitoring Agency, and government agencies. VECs were monitored to assess the impact of the mine on wildlife, with a major emphasis on caribou, carnivores, and upland breeding birds. Trained wildlife technicians, conducted surveys of all VEC species, and implemented Wildlife Effects Monitoring Plan. Assisted with database design, and communicated results and issues with government biologists.

Diavik Diamond Mine
Northwest Territories,
Canada

Conducted environmental and wildlife monitoring, trained environmental technicians, created wildlife monitoring database, and assisted with reporting for the Diavik diamond mine. Assisted with fish-out project.

Government of the Northwest Territories
Northwest Territories,
Canada

Conducted a functional review of geomatics use within the GNWT. Review included designing data collection protocol, conducting interviews, compiling and analyzing data, and reporting.

PUBLICATIONS

Other

Fisheries Studies at the Bluefish Hydroelectric Station. 2013. Prepared for the NWT Power Corporation.

Wildlife and Wildlife Habitat Protection Plan, and Wildlife Effects Monitoring Plan. NICO Project. Prepared for Fortune Minerals Inc.

Effects of Development on Barren-ground Caribou: Insight from Traditional Knowledge and Ecological Model. 2011. Prepared for the Kugluktuk Hunters and Trappers Organization.

Comprehensive Remediation Assessment Report for the Discovery Mine. 2010. Prepared for Indian and Northern Affairs Canada.

Wildlife and Wildlife Habitat Protection Plan, and Wildlife Effects Monitoring Plan. Gahcho Kue Project. Prepared for De Beers Canada Inc.

Terrestrial Environment and Project Effects Scoping Report, Bluefish Hydro Dam Replacement Project. Prepared for the Northwest Territories Power Corporation.

Taltson Hydroelectric Expansion Project Developer's Assessment Report. Prepared for Deze Energy Corporation for the Mackenzie Valley Environmental Impact Review Board.



Golder Associates 2008. 2007 Jericho Diamond Project Wildlife Monitoring Program Data Summary. Prepared for Tahera Diamond Corporation.

Autumn and Winter Wildlife Studies for the Taltson Hydroelectric Expansion Project. 2006. Prepared for the Northwest Territories Energy Corporation.

Wildlife and Wildlife Habitat Studies for The Taltson Hydroelectric Expansion Project. 2006. Prepared for the Northwest Territories Energy Corporation.

Environmental Baseline Studies at the NICO Property, 1998 to 2005. Prepared for Fortune Minerals Inc.

Wildlife Mitigation and Monitoring Plan. Jericho Diamond Project. 2005. Prepared for the Tahera Diamond Corporation.

Golder Associates 2005. Wildlife Monitoring Studies at the Snap Lake Diamond Project, 1999 to 2004. Prepared for De Beers Canada Inc.

Golder Associates 2004. Terrestrial and Aquatic Field Surveys and Ecological Risk Assessment for the Tundra Mine. Prepared for Indian and Northern Affairs Canada, Contaminants Division.

Golder Associates 2004. Enhanced Phase 2 Environmental Site Assessment of the Speers Lake Exploration Camp, Nunavut. Prepared for Public Works and Government Services Canada. Edmonton, Alberta.

Golder Associates 2004. Enhanced Phase 2 Environmental Site Assessment of the McGregor Lake Exploration Camp, Nunavut. Prepared for Public Works and Government Services Canada. Edmonton, Alberta.

Golder Associates 2004. Enhanced Phase 1 Site Assessment, El Bonanza Mine, Northwest Territories. Prepared for Indian and Northern Affairs Canada, Contaminants Division.

Golder Associates 2004. Enhanced Phase 1 Site Assessment, Indore Mine, Northwest Territories. Prepared for Indian and Northern Affairs Canada, Contaminants Division.

Golder Associates 2004. Colomac Site Remediation Plan Technical Review. Prepared for Indian and Northern Affairs Canada, Contaminants Division.

Golder Associates 2004. Phase 1 Environmental Site Assessment of a private commercial property. Prepared for the CIBC Bank, Yellowknife, Northwest Territories.

Golder Associates 2003. Phase 1 Environmental Site Assessment of the Former St. Anne Hospital Site, Fort Smith, Northwest Territories. Prepared for the Uncle Gabe Friendship Centre, Fort Smith, Northwest Territories.



Golder Associates 2003. Environmental Review of Diamond Mining Sector. Prepared by Golder Associates Ltd. for Environment Canada, Government of Canada.

De Beers 2002. Snap Lake Wildlife Monitoring Report. Prepared by Golder Associates for De Beers Canada Mining Inc.

BHP Billiton 2003. Ekati Diamond Mine 2002 Wildlife Effects Monitoring Program. Prepared by Golder Associates for BHP Billiton Diamonds Inc.

Golder Associates 2002. Environmental Impact Assessment for the WesternGeco Mackenzie River 2D Seismic Program. Prepared for WesternGeco.

Golder Associates 2002. Supporting Documentation for a Land Use Permit Application for a Northwest Tel Microwave Tower. Prepared for Northwest Tel.

Golder Associates 2002. A Functional Review of Geomatics within the N.W.T. Department of Resources, Wildlife, and Economic Development. Prepared for the department of Resources, Wildlife, and Economic Development, Government of the Northwest Territories.

BHP Billiton 2002. Ekati Diamond Mine 2001 Wildlife Effects Monitoring Program. Prepared by Golder Associates Ltd. for BHP Billiton Diamonds Inc.

Golder Associates 2002. Snap Lake Diamond Project Wildlife Monitoring Report. Prepared by Golder Associates for De Beers Canada Mining Inc.

Golder Associates. 2001. Environmental Impact Assessment of the Snap Lake Diamond Project. Prepared for De Beers Canada Mining Inc.

BHP 2001. Ekati Diamond Mine 2000 Wildlife Effects Monitoring Program. Prepared by Golder Associates Ltd.



Education

Ph.D. Civil Engineering - Fluid Mechanics, University of Canterbury, 1998

M.Sc. Civil Engineering - Water Resources, University of Alberta, Alberta, 1992

B.Sc. Civil Engineering - Co-op Program, With Distinction, University of Alberta, Alberta, 1990

Applied Fluvial Geomorphology, Dave Rosgen/Wildland Hydrology, 2001

Languages

English – Fluent

Affiliations

Association of Professional Engineers and Geoscientists of Alberta

Association of Professional Engineers and Geoscientists of British Columbia

Association of Professional Engineers and Geoscientists of Northwest Territories

International Association for Hydraulic Research

Canadian Institute of Mining, Metallurgy and Petroleum (Environment Section)

Canadian Water Resources Association

Golder Associates Ltd.

Dr. Nathan Schmidt has worked on mining projects across Canada, with an emphasis on the North. His scopes of practice include baseline hydrology, water management planning, design and environmental impact assessment. Nathan has played a key role in several northern EIAs and providing design services for these and other projects.

His recent work includes involvement with the Dominion Diamonds Jay-Cardinal and Lynx diamond projects, De Beers Gahcho Kue diamond project, the Giant Mine remediation project, the Agnico-Eagle Meliadine gold project and the Fortune Minerals NICO project. Nathan has extensive experience in fish habitat compensation and erosion and sediment control.

Nathan is registered as a professional engineer in Alberta, British Columbia and the Northwest Territories and Nunavut. He is the former chair of the APEGA Environment Committee and is currently in his fifth term on an NSERC Grant Selection Committee.

Employment History

Golder Associates Ltd. – Edmonton, AB

Associate then Principal, Senior Water Resources Engineer (2002 to Present)

Consultant and Project Manager on projects related to river engineering, hydrology, water management, and environmental impact assessment in the mining, water resources, power, forestry, and transportation market sectors.

Golder Associates Ltd. – Calgary, AB

Senior Water Resources Engineer (1997 to 2002)

Consultant and Project Manager on a variety of projects. Highlights included managing the climate and hydrology component of the Regional Aquatics Monitoring Program for five years, leading the surface water hydrology components of the CNRL Horizon Oil Sands Project EIA and Suncor Firebag In Situ Oil Sands Project EIA, and leading the Functional Design, Hydrology, and Hydraulics components of the Iron Ore Company Wabush Lake Tailings Management Project.

University of Canterbury – Christchurch, New Zealand

Research/Teaching Assistant, Fluid Mechanics (1993 to 1997)

Alberta Transportation & Utilities – Edmonton, AB

Bridge Planning Engineer (1992 to 1993)

University of Alberta – Edmonton, AB

Research/Teaching Assistant, Water Resources Engineering (1990 to 1992)

Stanley Associates Engineering Ltd. – Edmonton, AB

Hydrotechnical Engineer (1990 to 1990)





PROJECT EXPERIENCE – ENVIRONMENTAL IMPACT STUDIES

**Dominion Diamonds
Jay-Cardinal Project**
Lac de Gras, NT

Senior reviewer for baseline hydrology and impact assessment and senior advisor for water management at the Jay-Cardinal Project at the Ekati Diamond Mine. Participated in technical sessions with stakeholders and regulators.

**Giant Mine
Remediation - PWGS
Canada**
Yellowknife, NT, Canada

While developing preliminary design reports for the surface water and Baker Creek remediation components of this project, provided support to the impact assessment before the Mackenzie Valley Review Board, including technical session participation and writing responses to two rounds of Information Requests.

**TOTAL E&P Canada
Strathcona Upgrader**
Fort Saskatchewan, AB,
Canada

Component lead for the hydrology section of an Environmental Impact Assessment for a bitumen upgrader project. The assessment focused on disturbance to local drainage patterns, as well as the effects of water withdrawal and water intake construction on the North Saskatchewan River. The EIA was submitted to the Alberta Energy and Utilities Board and Alberta Environment.

**De Beers Canada
Gahcho Kué Diamond
Project**
NT, Canada

Responsible for the hydrology components of the Environmental Impact Statement for a proposed diamond mine located east of Yellowknife in the Lockhart River basin. Tasks included baseline data collection and preparation and submission of a baseline hydrology report and Environmental Impact Statement for submission to regulatory agencies. The proposed project will drain a small subarctic lake to access diamondiferous kimberlite pipes, and a major focus of the EIS was on downstream effects of water diversion during lake draining and refilling.

**Miramar Mining Doris
North Gold Mine
Project**
NU, Canada

Responsible for the hydrology components of the Environmental Impact Statement for a proposed gold mine on the Hope Bay Belt. This included an assessment of effects on a local lake due to withdrawals for water supply, development of a hydrological design basis for a fisheries compensation (No Net Loss) plan, and provision of input data for a tailings facility water balance. Done in conjunction with supplemental climate and hydrology data collection.

**Jivko Engineering –
Mackenzie River
Bridge**
Fort Providence, NT

Contributed to environmental impact assessment, including study of effects of ferry crossing decommissioning on sediment deposition into the Mackenzie River and effects of bridge pier and approach causeway construction on physical habitat characteristics.

**Canadian Natural
Resources Ltd. –
Horizon Mine**
Fort MacKay, AB,
Canada

Managed the surface water hydrology component of the impact analysis for the Horizon Mine project, located northwest of Ft. Mackay, Alberta. Tasks included preparation of a report detailing baseline climate, hydrology and geomorphology, identifying changes in site hydrologic conditions and sediment yields and impact on the Athabasca River due to the project and other planned developments.



Diavik Diamonds – Lac de Gras
NT, Canada

Project engineer responsible for developing a water balance model, calibrated to baseline site hydrological conditions, to quantify changes to Lac de Gras caused by the Diavik Diamond Mine. Conducted an impact analysis to quantify the incremental hydrologic impacts of the Diavik Diamond Mine project and the cumulative impacts of the Diavik and BHP projects. Tasks included identifying changes in site hydrologic conditions and water balance and describing changes in sediment yields and suggesting procedures for mitigating any impact on the environment. Analyzed climatic, snow survey and local stream gauging data to determine snowmelt and seasonal runoff coefficients from small watersheds on the east island and adjacent mainland in the Lac de Gras basin.

Suncor Energy Inc. - Firebag In Situ Project
Fort MacKay, AB, Canada

Performed a field reconnaissance to determine the origin of base flow in small tributaries to the Steepbank, Muskeg and Firebag Rivers. The area was surveyed for the existence of streams fed by springs originating in the sand and gravel aquifer beneath Muskeg Mountain. Responsible for hydrologic components of the environmental impact study.

PROJECT EXPERIENCE – MINE WATER

Giant Mine - Deton Cho Nuna
Yellowknife, NT, Canada

Provided detailed design services to the care and maintenance contractor of a gold mine, to address mine water management and erosion and sediment control concerns prior to closure.

Dominion Diamonds Lynx Project
Lac de Gras, NT

Senior reviewer for baseline hydrology and associated components of water licensing for the Lynx expansion at the Ekati Project. Participated in technical sessions with stakeholders and regulators.

Giant Mine Remediation - PWGS Canada
Yellowknife, NT, Canada

Task lead for surface water drainage and Baker Creek components of this mine closure and remediation project. Prepared preliminary design reports for the two components, including preliminary engineering designs and Class B cost estimates suitable for presentation to the Treasury Board of Canada for funding applications. The work included consultation with stakeholders including Fisheries and Oceans Canada, Environment Canada, Northwest Territories Environment and the project owner, Aboriginal Affairs and Northern Development Canada. Also developed a high-level erosion and sediment control plan for the project in care and maintenance.

Fortune Minerals NICO Project
North of Wha Ti, NT

Senior reviewer for the erosion and sediment control plans for this Gold-Cobalt-Bismuth-Copper mine. Contributed to the surface water related components of the water licence application.

TransAlta Pit 9 Geomorphology and Closure Planning
Duffield, AB, Canada

Senior reviewer for geomorphological characterization and mine closure drainage planning for the Highvale Mine Pit 9 in the North Saskatchewan River valley.

PWGSC Tundra Mine Remediation
NT, Canada

Component lead for hydrological modeling at the Tundra Mine site, for a remediation project funded by Public Works and Government Services Canada. Developed a water balance model to evaluate the effects of remediation alternatives and design parameters on refilling duration and water yields in an evaporation-dominated, subarctic environment.



**Agnico Eagle
Meadowbank Gold
Mine Project**
Kivalliq, NU, Canada

Senior reviewer and engineer of record for water management infrastructure. Project components included a mine surface water management plan and a submerged diffuser-style wastewater outfall. Design documents were used to support a Type A Water License application to the Nunavut Water Board.

**De Beers Snap Lake
Project**
NT, Canada

Hydrology and water management tasks contributing to an alternative evaluation of measures to manage and mitigate mine water inflows. Prepared a mine water management plan to satisfy regulatory requirements for the mine water license.

**Fording Coal Ltd. –
Greenhills Mine**
Elkford, BC, Canada

Preliminary site assessment of requirements for dam break inundation study component of Emergency Preparedness Plan for the main and west tailings dams.

**Syncrude Canada Ltd.
– Aurora North Mine**
Fort McMurray, AB,
Canada

Project manager for evaluation of clean water diversion alternatives at the Aurora North mine, including outlets to Stanley Creek, the Muskeg River, Mills Creek, Fort Creek and the Athabasca River. The evaluation considered economic, environmental and technical/operational criteria to determine the best alternative. Served as project manager for the next phase of the project, which involved detailed design of ditch, pump and pipeline facilities for clean water diversion.

**Canadian Natural
Resources Ltd. –
Horizon Mine**
Fort MacKay, AB,
Canada

Manager for development of operational water management plan, closure reclamation drainage plan and conceptual design of the Athabasca River water intake. The operational water management plan included development of design criteria consistent with best management practices for oil sands mining operations, design of site-specific surface drainage, dewatering and diversion systems, development of a basal aquifer dewatering plan, development of a mine water balance for closed-circuited areas and derivation of raw water supply requirements for mining operations. The closure reclamation drainage plan involved the development of a progressive drainage plan, incorporating hydrologic and geomorphic considerations to ensure sustainability of the drainage system and landscape.

**Syncrude Canada Ltd.
– Aurora North Mine**
Fort McMurray, AB,
Canada

Project manager for development of an operational water management plan for 10 years of mining activities, including a review of design criteria with specific application to Aurora North mine components, an assessment of surface water hydrology and drainage facilities at the mine, development of a muskeg and overburden dewatering plan and development of guidelines for sizing mine pit sumps and pumps.

TrueNorth Energy
Fort McMurray, AB

Developed water management infrastructure designs for the TrueNorth Energy Fort Hills project plant site.

Albian Sands Energy
Fort McMurray, AB

Update of closure reclamation drainage plan for mine components addressed in the 10-year conservation and reclamation plan. Component lead for a project to evaluate the alternatives and feasibility of release of saline basal aquifer water to surface water receiving environments.

**Quintette Coal –
Deputy and Shikano
Common Pits**
Tumbler Ridge, BC

Review of hydrologic studies for this area, including derivation of design discharges for closure planning. Design of closure drainage facilities for two catchments, including feasibility-level design of a stepped spillway in bedrock for the Shikano Common pit.



Iron Ore Company of Canada – Wabush Lake
Labrador City, NL, Canada

Task manager for hydrology and functional design components of this tailings management project. Responsible for baseline data collection and hydrological simulation model of the Wabush/Shabogamo Lake watershed, which was used to characterize baseline conditions and model the impacts of a tailings management system on the lake. Responsible for documenting and modeling ice conditions on the lake and assessing changes to the lake ice regime due to the tailings management system. Other tasks included lake bathymetry, water quality profiling, sediment sampling, infiltration testing on terrestrial tailings deposits, and training client personnel for hydrological data collection.

Quintette Coal – Babcock Window Pit
Tumbler Ridge, BC, Canada

Prepared water management plans for the Babcock Window pit and haul road at Quintette Operating Corporation’s mine near Tumbler Ridge. Performed an analysis of available climatic and hydrologic data to determine site runoff and designed a sedimentation pond in accord with Provincial guidelines. Prepared quantity and cost estimates for construction.

Syncrude – Beaver River Diversion
Fort McMurray, AB, Canada

Prepared feasibility-level designs for several river diversion alternatives considered during closure planning for the Mildred Lake facility north of Ft. McMurray. Prepared quantity and cost estimates based on these designs and performed a net present value analysis to compare alternatives.

PROJECT EXPERIENCE – FISH HABITAT AND STREAM RESTORATION

Agnico Eagle Meadowbank Gold Mine Project
Rankin Inlet, NU

Senior reviewer and engineer of record for fish habitat compensation works design, developed to compensate for mine and access road development. Compensation measures included submerged reef structures in a lake environment and spawning riffles in an arctic river.

Whitemud Creek Erosion Study
Edmonton, AB, Canada

Project manager an assessment of existing erosion and evaluation of future erosion potential under urbanized conditions. The project involved intensive data collection for approximately 40 km of stream length on Whitemud and Blackmud Creeks within the City limits. It included assessments of stream hydrology, geomorphology and valley wall instability, with the objective of identifying and prioritizing areas for application of mitigation measures.

Big Island Lake Stabilization
Strathcona County, AB, Canada

Project manager responsible for establishing the pre-disturbance water level regime of a small prairie lake and performing feasibility-level design of a control structure to restore the lake level. Included field surveys, hydrological and hydraulic modeling, environmental assessment and public consultation.

Miramar Doris North Gold Mine Project
NU, CANADA

Engineer of record for design of fish habitat compensation works at the Doris North project, developed to compensate for mine, access road and port development. Compensation measures included spawning and rearing reef structures in lake and marine environments, rearing habitat in small streams, and fish passage mitigation works.

ASRD – Watershed Integrity Study
AB, CANADA

Senior reviewer for a project commissioned by Alberta Sustainable Resource Development (ASRD) to use GIS methods to develop fish-based Indices of Biological Integrity (IBI) for Battle River sub-watersheds. The study used source data, including urban density, road network density and agricultural use to prepare maps that predicted levels of disturbance and IBI.



- EPCOR Water Services – Fish Habitat Compensation**
Edmonton, AB

Senior technical advisor to fish habitat compensation design for two rock riprap spurs on the North Saskatchewan River. These were developed to compensate for the effects of a new water intake structure for the E.L. Smith Water Treatment Plant.
- CN Rail – Fish Habitat Compensation**
Wabamun Lake, AB,
CANADA

Senior technical advisor to fish habitat compensation design on False Creek, at the west inlet to Wabamun Lake. The project involved bank stabilization and habitat enhancement to provide compensation for damage caused by oil released during a train derailment.
- North Saskatchewan Watershed Alliance**
Edmonton, AB,
CANADA

Hydrology and geomorphology component lead for the NSWA Instream Flow Needs (IFN) scoping study. This project was the first step in a process for watershed management under the framework of the Alberta Water for Life strategy, with the NSWA serving as the WPAC for the NSR.
- EPCOR Power – Keephills 3 Fish Exclusion**
Keephills, AB, CANADA

Prepared a study addressing fish exclusion at two river water intakes, two cooling pond intakes and a reservoir blowdown structure. These were used to evaluate alternatives for expansion of a coal-fired power generation facility and were used as a basis for discussions with regulatory agencies.
- Provincial Watercourse Crossing Committee**
Keephills, AB, CANADA

Senior technical advisor for a study entitled “Culvert stream crossings in Alberta – a review and evaluation of current practices” that examined legislation and regulations; standards and specifications; best management practices; education and outreach; stewardship; biological information; and landscape data. The intent of the project was to summarize and identify deficiencies in available information, and provide recommendations that might be effective in improving existing standards and procedures.
- Murray-Cheslatta Stream Restoration Scoping Study**
Prince George, BC

Hydrology and geomorphology component lead for a literature review addressing restoration alternatives for a river system that was previously degraded by a large scale stream diversion. This work was done for the Nechako Enhancement Society.
- City of Edmonton – Clover Bar Creek Restoration**
Edmonton, AB,
CANADA

Project manager an assessment of existing erosion and evaluation of future erosion potential under urbanized conditions. Undertook an intensive site reconnaissance on 5 km of stream length, assessed erosion potential and developed recommendations for restoration of existing erosion and treatments to prevent erosion under the future, urbanized flow regime. The project included a comprehensive alternative evaluation and quantity and cost estimates for selected alternatives. Later participated in process to resolve dispute over funding responsibilities between two municipalities.
- Regional Municipality of Wood Buffalo**
Fort McMurray, AB,
CANADA

Project manager and lead engineer on a project to revitalize the Snye, a waterbody located upstream of the confluence of the Athabasca and Clearwater rivers. The Athabasca end of the Snye was blocked by causeway construction in the late 1960’s, resulting in siltation and stagnation. This project included field surveys, a hydrology study and development of a feasibility-level design for hydraulic structures to manage flow through the Snye to enhance water quality and maintain a self-scouring inlet for navigation at the Clearwater entrance.
- DFO – Nulahugyuk Creek**
Bernard Harbour, NU

Undertook a field reconnaissance and provided hydrology and geomorphology input to a study of an Arctic stream, to determine reasons why the historic Arctic char spawning run has not occurred in recent years and to develop remedial measures.



**Foothills Model Forest
– Hardisty Creek
Restoration**
Hinton, AB, CANADA

Project manager for fisheries and hydrological assessment and development of remediation measures for stream restoration and fish passage. Responsible for addressing concerns of stakeholders including industry, regulatory agencies, municipalities and environmental groups. The project included several phases, including assessment and design (2003-4), construction of stream restoration prescriptions (2004) and construction of a 1.8 m high riffle to backflood a culvert for fish passage (2005).

PROJECT EXPERIENCE – MANUALS AND GUIDELINES

**Alberta Gravel Pit
Development BMP
Guideline**
Edmonton, AB, Canada

Served as a senior reviewer for a project to develop the Best Management Practices User Manual for Aggregate Operators on Public Land, developed for Alberta Sustainable Resource Development in collaboration with the Alberta Sand and Gravel Association.

**Agriculture Canada
IWRM Guideline**
Brandon, AB, Canada

Served as project manager and contributing author for development of several modules and factsheets for an Integrated Water Management Guideline being developed internally by Agriculture and Agri-Food Canada. Phase 1 of the project included developing final drafts of 7 manual modules related to integrated water management in an agricultural context, and Phase 2 of the project included developing 35 factsheets describing various indicators related to agricultural water supply reliability, drainage, water use and conservation.

**TAC National Guide to
Erosion & Sediment
Control**
Ottawa, ON, Canada

Primary author and project manager for development of the TAC National Guide to Erosion and Sediment Control on Roadway Projects. This document was developed with the TAC Project Steering Committee, with review by the TAC Environmental Issues Subcommittee, the TAC Environment Council and the TAC Chief Engineer’s Council, and it was subject to review and comments by Fisheries and Oceans Canada (DFO) at the regional and national levels. The intent of the document was to address erosion and sediment control regulatory issues, physical theory and risk assessment, as well as provide methods for developing erosion and sediment control plans over the life cycle of a project.

**TAC Erosion &
Sediment Control
Training**
Ottawa, ON, Canada

Provided technical input into development of a one-day training course based on the TAC National Guide to Erosion & Sediment Control on Roadway Projects, and subsequently led deliveries in Vancouver, Calgary, Red Deer, Ottawa, Saskatoon, Edmonton (2), Winnipeg, Fredericton (3) and Prince George.

**Alberta Transportation
Fish Habitat Manual**
Edmonton, AB, Canada

Co-author of the AT&U Fish Habitat Manual: Guidelines and Procedures for Watercourse Crossings in Alberta. Wrote chapter on Erosion and Sediment Control Plan, including sample plans for bridge and culvert construction, and subsequently revised the chapter on Fish Passage. Prepared factsheets describing recommended mitigation procedures.

**TAC Synthesis of
Practice for the
Protection of Fish
Habitat**
Ottawa, ON, Canada

Contributed to, and compiled, TAC's Synthesis of Practice for the Protection of Fish Habitat. This document discusses the integration of habitat issues into transportation and stream crossing planning, reviews regulatory approval requirements and presents best management practices for habitat protection, channel design, fish passage and erosion and sediment control.



MTO Gravity Pipe Manual
Toronto, ON, Canada

Senior technical reviewer for the Ontario Ministry of Transport (MTO) Gravity Pipe Design Manual. This document considered round pipes of less than 3 m diameter, including life cycle costing and risk analysis for concrete, steel, PVC and polyethylene materials.

DFO Culvert Guideline
Ottawa, ON, Canada

Contributor to the Fisheries and Oceans Canada (DFO) Guidance Document for Culvert Installation Modification and Maintenance.

PROJECT EXPERIENCE – HYDROLOGY/HYDROGRAPHICS

Comaplex Meliadine West Project 2007-2010
NU, Canada

Performed a site reconnaissance was undertaken to determine station locations and locations relative to proposed mine infrastructure. Managed an annual hydrometric program and completion of the climate and hydrology components of an aquatic baseline synthesis report, including historical data and hydrological modeling to characterize long-term baseline conditions.

North Saskatchewan River Hydrographics 2003-12
Keepihills, AB, Canada

Project manager for hydrographic and terrestrial surveys to monitor erosion and sedimentation over a reach length of approximately 1.5 km. The project also included use of an Acoustic Doppler Current Profiler (ADCP) to measure the velocity structure of flows on ten cross-sections along the reach.

Bruce Power Peace River NGS Baseline
Peace River, AB

Component lead for baseline studies to support the impact assessment and potential development of a nuclear generating station on the Peace River, north of Peace River, Alberta.

Genesee Expansion Baseline
Genesee, Alberta, Canada

Component lead for baseline studies to support the impact assessment of a coal mine and power generating station expansion. Tasks included characterizing hydrological regime and geomorphology of local watercourses and the North Saskatchewan River.

Miramar Doris North Hydrological Monitoring 2003-8
NU, Canada

Responsible for the installation and operation of stream discharge and water level monitoring stations at the Project. Three stations were operated in 2003, six in 2004 and 2005, 17 in 2006 and 2007 and 18 in 2008. They were installed in stream, lake and marine environments. Tasks included manual stream gauging, development of stage-discharge rating curves and processing of data used to characterize the local hydrological regime. Additional tasks included spring snowcourse surveys to measure snow depths and snow water equivalents on the range of aspects and terrain present at the project.

De Beers Gahcho Kué Project Monitoring 2007, 2010, 2011
NT, Canada

Managed the installation and operation of six continuous hydrometric stations. Tasks included manual stream gauging, development of stage-discharge rating curves and processing of data used to characterize the local hydrological regime.

Triex Mountain Lake Project
NU, Canada

Component lead for manual hydrometric monitoring and site reconnaissance at a uranium mining exploration project.

Dundee George & Goose Hydrological Monitoring 2005
NU, Canada

Managed the installation and operation of one continuous and two manual stream discharge and lake level monitoring stations at the Dundee Precious Metals George and Goose (Back River) Project. Tasks included manual stream gauging, development of stage-discharge rating curves and processing of data used to characterize the local hydrological regime.



CNRL – Primrose and Wolf Lake Expansion Project
AB, Canada

Responsible for initial scoping of the climate and hydrology baseline study, including definition of the local and regional study areas and identification of existing sources of data. Responsible for recommendations and cost estimates for the local climate and hydrology monitoring program.

Oil Sands Climatic & Hydrological Monitoring 1998 to 2002
AB, Canada

Managed the climate and hydrology component of the Regional Aquatics Monitoring Program (RAMP). This study of various streams and lakes in the oil sands area included approximately 35 hydrometric stations and three climate stations from Janvier in the south to the Firebag River in the north. It included the Athabasca River, Muskeg River and tributaries, Birch Mountains drainages, Poplar Creek, Kearl, McClelland and Isadore’s Lakes. Responsible for the collection of data from climatic monitoring stations in the area and for undertaking snow surveys in various study areas. Analysis included processing stream discharge and water level data, preparing stage-discharge rating curves and synthesizing hydrographs. All available local and regional data were compiled in a database for easy reference. Provided data support to RAMP funders and to authorized third parties, including regulatory agencies, consultants and contractors.

Oil Sands Regional Hydrological Modeling
Fort McMurray, AB, Canada

Project manager for development of a regional hydrological (HSPF) model of the oil sands region. This model has subsequently been used as the basis for several environmental impact assessment baseline reports. The model was also used as the basis for development of design runoff curves for mine operational water management.

De Beers Canada Mining Inc. - Snap Lake Project
NT, Canada

Managed the baseline hydrology study, including acquisition and processing of local snowpack, stream discharge and water level data. Responsible for the installation and operation of three stream discharge monitoring stations and one lake level monitoring station at Snap Lake.

OPTI Canada Ltd. – Long Lake Project
AB, Canada

Task manager for spring 2000 snow survey. Participated in initial scoping of the climate and hydrology baseline study, including identification of existing sources of data. Responsible for recommendations and cost estimates for the local climate and hydrology monitoring program.

Synenco Field Reconnaissance
AB, Canada

Led a field reconnaissance to identify potential locations for hydrometric monitoring activities to support baseline hydrological data collection. The study area was located in the Marguerite River watershed, approximately 100 km north of Fort McMurray.

Suncor Firebag River Field Reconnaissance
AB, Canada

Performed a field reconnaissance to determine the origin of base flow in small tributaries to the Steepbank, Muskeg and Firebag Rivers. The area was surveyed for the existence of streams fed by springs originating in the sand and gravel aquifer beneath Muskeg Mountain.

Syncrude Canada Ltd. - Mildred Lake
Fort McMurray, AB, Canada

Performed a regional hydrological analysis of Environment Canada–Atmospheric Environment Service precipitation and evaporation data to derive inflows to approximately 70 lakes in the region. This information was used in an environmental impact study of airborne emissions on lake water quality.

Mackenzie River near Fort Providence
NT, Canada

Observed and collected field data during the period of ice breakup to be used in a study to identify factors influencing the date of river breakup. Relevant data included river stage, ice characteristics and Water temperatures.



PROJECT EXPERIENCE – PIPELINES

Pipeline Crossing Overview

Nathan has led pipeline watercourse crossing designs for oil, gas, bitumen, diluent and water pipelines, primarily in Alberta, for Shell, Enbridge, TCPL, Anadarko, Talisman and other companies. These assignments typically involve characterizing the hydrological regime at the crossing, modeling watercourse hydraulics, including scour potential, and considering the fluvial geomorphology at the crossing to assess lateral channel migration potential. The results of this analysis are used to specify pipeline burial depths, sagbend setbacks and associated mitigation measures to prevent exposure over the operating life of the pipeline. This work also typically contributes to regulatory applications and compliance, under Alberta Water Act Codes of Practice, Environmental Protection Plans and Conservation and Reclamation Plans, and support for applications under the Canada Fisheries Act, Navigable Waters Protection Act and National Energy Board Act.

PROJECT EXPERIENCE – BRIDGES, CULVERTS AND BANK PROTECTION

River Crossing and Bank Protection Overview

Nathan has led the hydrotechnical component of stream crossing assessment and design for numerous public and private organizations, including hydrotechnical designs for over a dozen highway bridges in Alberta and British Columbia, hydrotechnical assessments for dozens of sites in Alberta, river protection works in Alberta and British Columbia, and mine access road crossings in Alberta, the Northwest Territories and Nunavut. These assignments typically involve characterizing the hydrological regime at the crossing, modeling watercourse hydraulics, including scour potential, and considering the fluvial geomorphology at the crossing to assess channel stability. The results of this analysis are used to specify waterway openings, structure elevations and headslope armour requirements. Many assignments included regulatory tasks including provincial and federal agencies.

PROJECT EXPERIENCE – EROSION AND SEDIMENT CONTROL

Erosion and Sediment Control Overview

Nathan has over ten years experience at erosion and sediment control planning, regulatory compliance, guidance document preparation and training delivery. This includes assignments in northern environments, including Giant Mine care and maintenance activities, the Mackenzie Valley Winter Road and the Bluefish Hydro dam replacement project. He was the primary author of the TAC National Guide to Erosion and Sediment Control on Roadway Projects and is the current lead instructor for the associated training course.

PROJECT EXPERIENCE – MUNICIPAL & INDUSTRIAL WATER MGMT

Lowe's Site Assessment Alberta, Canada

Senior reviewer for a site assessment at proposed Lowe's big box store locations in South Edmonton Common, Stony Plain Road West, Clareview and Red Deer, including flooding and site water management issues and regulatory compliance.

TOTAL E&P Canada Strathcona Upgrader Ft. Saskatchewan, AB

Served as senior technical advisor for a water intake scouting study on the North Saskatchewan River, including field studies and alternatives evaluation.



**City of Edmonton
Environmental
Monitoring Program**
Edmonton, AB, Canada

Project manager for the City of Edmonton's Environmental Monitoring Program (EMP) and North Saskatchewan River (NSR) monitoring program, 2006-2012. This program included dry weather and storm event monitoring of storm sewer and combined sewer outflows, stormwater management ponds, the NSR and tributaries. A quasi-realtime monitoring program was also conducted by sampling from industrial and municipal water intakes, while considering NSR travel times.

**TrasnAlta Sundance
NGCC Plant**
Alberta, Canada

Senior reviewer for a stormwater management assessment of a proposed natural gas combined cycle (NTCC) power plant on the Sundance Cooling Pond, south of Wabamun Lake. Also responsible for evaluation of water supply issues from the North Saskatchewan River.

**Morris Wetland
Hydrology**
Alberta, Canada

Senior advisor for a study to evaluate mitigation measures required for remediation of an existing stormwater management pond, with a planned contaminated sediment remediation and conversion to a constructed wetland.

**Alta Steel Stormwater
Management Pond**
Alberta, Canada

Senior reviewer for a study to evaluate the performance and regulatory compliance for an industrial stormwater pond at a steel recycling facility in the City of Edmonton, discharging to Gold Bar Creek.

**Confidential Client –
Water Supply Scoping
Study**
Fort Saskatchewan, AB,
Canada

Authored a scoping study to examine water supply and wastewater disposal issues related to development of a bitumen upgrader in Alberta's Industrial Heartland. The study examined the hydrological characteristics of the North Saskatchewan River and other potential sources of water supply and wastewater disposal. It provided a review of regulatory issues related to site development and water supply, including the draft Alberta Environment Water Management Framework, and discussed the role of regulatory and stakeholder bodies.

**Confidential Client -
Industrial Heartland
Water Management**
Alberta, Canada

Reviewed stormwater management pond design for an industrial site in Alberta's Industrial Heartland for a confidential client, provided recommendations for pond sizing and overall site water management, and completed regulatory application for stormwater management.

**Government of
Northwest Territories
DOT**
Sahtu Region, NT,
Canada

Provided hydrological data collection and analysis for eighteen watercourses along the Mackenzie Valley Winter Road to assess their viability for winter water supply. These watercourses are regulated by the Mackenzie Valley Water Board and Fisheries and Oceans Canada to prevent harm to aquatic life. The study considered site-specific data collected for the project and for previous studies, including the Mackenzie Gas Project (2002-2004) and Arctic Gas Project (1972-73), as well as long-term regional data collected by Environment Canada.

**Athabasca River Water
Intake Construction
Monitoring**
Fort MacKay, AB

Project director for provision of environmental monitoring services at the Canadian Natural Resources Ltd. Athabasca River water intake. Golder monitored sediment and other water quality parameters to ensure regulatory compliance.

Rio Tinto Alcan Facility
Alberta, Canada

Performed an assessment of an existing coke handling facility in Strathcona County to evaluate compliance with stormwater management regulations.

**Mackenzie Property
Stormwater Mgmt**
Alberta, Canada

Senior advisor/reviewer for design and permitting of remedial stormwater measures at a country residential property, after the client had been issued a remediation order by a provincial regulatory agency.



- Alberta Infrastructure
ASAP2 School Siting
Studies**
Alberta, Canada

Undertook reviews of available flood hazard assessment information for 14 proposed schools in southern Alberta to establish whether they were situated above the 1:500 year flood level. This was done to determine their suitability for use as community disaster response facilities. Where necessary to fill data gaps, supplementary hydrological and hydraulic studies were performed.
- Capital Power Genesee
Generating Station**
Genesee, AB, Canada

Project manager responsible for hydrological and water quality studies to support permit applications for a new water licence at the Genesee Generating Station, to enhance water quality in the cooling pond. Tasks included participation in a community consultation workshop.
- Alberta Infrastructure
P3 Hospital Siting
Studies**
Northern Alberta,
Canada

Served as the project manager for siting studies of proposed P3 hospital projects in Edson, Grande Prairie and High River, and as the component lead for flood hazard assessment. The purpose of each flood hazard assessment was to establish whether the locations were situated above the 1:1000 year flood level, because these are critical disaster response facilities. Supplementary hydrological and hydraulic studies were performed at the Edson and High Prairie sites to fill gaps in the available data.
- Alberta Infrastructure -
LETC Siting Studies**
Fort McLeod, AB,
Canada

Component lead for flood hazard assessment at a proposed Law Enforcement Training Centre at Fort McLeod, adjacent to the Oldman River. The work entailed desktop studies to evaluate whether proposed location was situated above the 1:500 year flood level, to confirm its suitability for use as a community emergency response location. Existing information was compiled and evaluated, and supplementary hydrological and hydraulic studies were performed.
- Alberta Infrastructure -
ASAP3 School Siting
Studies**
Southern Alberta,
Canada

Component lead for flood hazard assessments at 13 proposed schools in southern Alberta. The work entailed desktop studies to evaluate whether proposed school locations were sited above the 1:500 year flood level, to confirm their suitability for use as community emergency response locations. Existing information was compiled and evaluated, and where necessary, supplementary hydrological and hydraulic assessments were performed.
- Peace River Oil –
Bluesky Upgrader**
McLennan, AB, Canada

Prepared a water supply scoping study for a proposed bitumen upgrader. Evaluated surface water supply alternatives based on hydrological and ice characteristics and provided quantity and cost estimates.
- CN Rail – McLennan &
Grande Prairie Yards**
Alberta, Canada

Senior technical advisor for water quality assessment and remedial drainage design for a rail yard, including topographic and drainage surveys, water quality sampling conceptual and detailed design of mitigation measures.
- Hwy 679 and 749
Drainage Study**
High Prairie, AB,
Canada

Project manager for assessment and remedial drainage design of two intersecting sections of rural highway. Project components included a field reconnaissance, site surveys, interviews with local residents and hydrological modeling to evaluate deficiencies in the existing system and to develop design recommendations to mitigate flooding.
- Igloo Building
Products**
Stony Plain, AB, Canada

Project manager for drainage design of an 80 ha parcel of land in the Acheson Industrial Park. The project included hydrological modeling and grading design to meet Province of Alberta and Parkland County regulations.
- Golden West Homes**
Stony Plain, AB, Canada

Project manager for stormwater management permitting (Alberta Water Act) drainage design of an 11 ha parcel of land in Parkland County. The project included hydrological modeling to meet provincial and county regulations.



County of Vermilion River
Kitscoty, AB, Canada

Golder was a subconsultant to Urban Systems Limited on this water supply study for the County of Vermilion River, and was responsible for the surface water hydrology, hydrogeology and geographic information systems components of the project. Served as the Golder project manager and senior reviewer. Long-term hydrometric data were used to determine water supply availability under mean and 10-year dry conditions, including an allowance for Instream Flow Needs. The GIS component included analysis of groundwater and surface water supply as well as the results of a public consultation.

Prairie Farm Rehabilitation Administration
Barrhead, AB, Canada

Golder was a subconsultant to Urban Systems Limited on this water supply study for Barrhead County, and was responsible for the surface water hydrology, hydrogeology and geographic information systems components of the project. Served as the Golder project manager and was responsible for the hydrology analysis. Long-term hydrometric data were used to determine water supply availability under mean and 10-year dry conditions, including an allowance for Instream Flow Needs. The GIS component included analysis of groundwater and surface water supply as well as the results of a public consultation.

PROJECT EXPERIENCE – SERVICE

- 2012-2014 NSERC Grant Selection Committee, Research Tools & Instruments
- 2011- Stollery Children's Hospital / Edmonton Rowing Club "Row for Kids" fundraiser - Co-chair (2011) then Chair (2012-)
- 2009-2011 NSERC Grant Selection Committee, Civil Engineering Environment
- 2003-2010 APEGA Environment Committee (Chair, 2004-2010)
- 2002-2009 Consulting Engineers of Alberta Environment Committee
- 2004-2009 Canadian Water Resources Association, Alberta Director
- 2005 CSCE 17th Hydrotechnical Conference – Technical Program Chair and Proceedings Editor
- 2005 CWRA National Conference – Organizing Committee

PUBLICATIONS

Schmidt, N., D. Ciobotaru, Z. Craciunescu and L. Purcka. 2011. Hill Creek Culvert Fish Passage Remediation. Canadian Society for Civil Engineering, 20th Canadian Hydrotechnical Conference, Ottawa, 14-17 June 2011, 10 p.

Schmidt, N.P. 2009. North Saskatchewan River - Industrial Heartland Hydrology and Water Supply. Invited Presentation, Canadian Water Resources Association Workshop, 6 February 2009.

Schmidt, N.P. 2009. North Saskatchewan River - Emerging Water Supply Challenges and Mitigation. Invited Presentation, Canadian Society for Civil Engineering Luncheon, 29 January 2009.

Schmidt, N.P. 2008. Water Supply Issues at Alberta's Industrial Heartland. Invited Presentation, 2nd Annual Heavy Oil Conference, Edmonton, 29 May 2008.

Trevor, B, D. Vanderwel and N. Schmidt. 2007. Erosion Study and Risk Assessment of Whitemud and Blackmud Creeks, Edmonton, Alberta. 18th Canadian Hydrotechnical Conference, Winnipeg, Manitoba, August 22-24, 2007.

Schmidt, N. 2007. The Hardisty Creek Restoration Project. Canadian Water Resources Association National Conference, Saskatoon, Saskatchewan, June 25-28, 2007. Poster presentation.



Schmidt, N., ed. 2005. Proceedings of the 17th Canadian Hydrotechnical Conference. Edmonton, Alberta, August 17-19, 2005, 1016 p.

Schmidt, N.P., G.R. Ash, H. Wilson and C. Duane. 2004. Climate and Hydrology Data Collection for Northern Mine Development. Canadian Institute of Mining, Metallurgy and Petroleum Mining North, Edmonton, 9-12 May, 2004, 8 p.

Biftu, G., N.P. Schmidt, A. Beersing and L.F. Sawatsky. 2004. Consideration of Potential Effects of Climate Change and Resulting Hydrologic Impacts on Mine Developments. Canadian Institute of Mining, Metallurgy and Petroleum Mining North, Edmonton, 9-12 May, 2004, 8 p.

Schmidt, N.P., A. Beersing, G. Biftu and F. Ade. 2004. Application of the Hydrological Simulation Program FORTRAN (HSPF) Model to Two Large Scale Environmental Impact Assessments in Northeastern Alberta (Abstract and Presentation Only). 24th Annual Conference of the International Association for Impact Assessment, Vancouver, 25-29 April, 2004.

Doram, D., S. Tuttle, N. Schmidt, P.Keele, K. Mackenzie and C. Duane. 2004. The Canadian Natural Horizon Mine Closure and Reclamation Plan. Society for Ecological Restoration and Canadian Land Reclamation Association, SER2004 - 16th annual World Conference on Ecological Restoration, Victoria, August 24-26, 2004 (Abstract and Presentation Only).

Mackenzie, I.B., G. Herasymuik, N. Schmidt, Z. Kovats and K. Clipperton. 2004. Environmental Impact Assessments in the Alberta Oil Sands Area. Western Canada Oil Sands Summit, Calgary, Alberta, 29-30 January 2004, 25 p.

Schmidt, N.P. and R.H. Spigel. 2000. Second Mode Internal Solitary Waves I – Integral Properties. Fifth International Symposium on Stratified Flows, Vancouver, 10-13 July, 2000, 6 p.

Schmidt, N.P. and R.H. Spigel. 2000. Second Mode Internal Solitary Waves II – Internal Circulation. Fifth International Symposium on Stratified Flows, Vancouver, 10-13 July, 2000, 6 p.

Metikosh, S. and N. Schmidt. 2000. Developing and Implementing Effective Compensation Measures. Presented to Synergy for Prosperity: Consulting Engineers of Alberta, Alberta Transportation and Alberta Roadbuilders and Heavy Construction Association Annual Conference, Edmonton, March, 2000.

Bender, M., S. Metikosh, L. Sawatsky, N. Schmidt and D. Snider. 1999. Mitigation Strategies for Watercourse Habitats at New Road Crossings: Alberta Transportation and Utilities Fish Habitat Manual, Canadian Society for Civil Engineering Conference, Regina, SK, 10p.

Schmidt, N. 1992. Flow in Ice Covered Channels, M.Sc. Thesis presented to the University of Alberta, Department of Civil Engineering, 200 p.

Schmidt, N. 1997. Generation, Propagation and Dissipation of Second-Mode Internal Solitary Waves, Ph.D. Thesis presented to the University of Canterbury, Department of Civil Engineering, 400 p.

Schmidt, N., and R.H. Spigel. 1997. Advanced Flow Visualisation Techniques Used in Fluids Research, UC Research, University of Canterbury Research Committee, July 1997, pp 48-49.



Daniel Johnson, P.E., VP Projects, 30+ Years Industry Experience

Dan has over 30 years of experience as a civil engineer and professional mining engineer. His expertise ranges from mine design, construction, and operations to finance and corporate management. Dan has designed, constructed and operated mines across the globe. His experience also includes running public companies. He is an accomplished leader in the mining industry, being able to prove time and again that he is able to deliver results throughout his progressive career from construction engineer, project engineer, operations superintendent, mine manager, project development manager, general manager, and company CEO and President.

Major Responsibilities

- Manage feasibility projects
- Provide marketing and business management
- Develop and organize policies, procedures, and systems for safety
- Cost engineering
- Budget preparation

Relevant Industrial Experience

JDS Energy & Mining Inc., Kelowna, BC

2007- Current

Project Development, Design Build and Management

- Provide project development, design, permit, construction, operation and maintenance, consulting and construction management services to various worldwide energy and mineral companies in early stage execution through to production
- Provide marketing and business management
- Manage project evaluation and feasibility studies

JDS Projects - acted as lead manager:

- Yellowhead Mining – Harper Creek Project, BC
- The Pebble Partnership (Anglo American – Northern Dynasty) – Pebble Project, Alaska
- Mountain Province/DeBeers – Gahcho Kue Project, NWT
- MMG Minerals – High Lake, Izok Lake
- Harry Winston – confidential property evaluation
- Morley Group – Waterhen and Longnose properties, Minnesota
- Norsemont – Constancia Copper Project, Peru
- Anvil Mining – Technical Due Diligence, Congo

Tahera Diamond Corp., Toronto/Nunavut

2004 – 2007

Executive Vice President, Operations

Accountable for leading the safe design, construction and operation of the Jericho Diamond Mine in Nunavut.

- Managed Feasibility Study for project



Daniel Johnson

- Assisted in company financing efforts and obtained vendor financing for project
- Selection and commercial negotiation of engineering, supply, construction contractors
- Developing organization policies, procedures and system for safety, financial, HR, IR, Community relations and process control
- Recruited, hired, directed operations management and operating team members
- Project was constructed in 11 months after receiving permit and on budget.
- Construction completed without lost time injury

Diamond Fields International, Vancouver, BC

1997 - 2001

President and CEO

Accountable for general management of Diamond Exploration Company

- Raised capital to fund company operations
- Registered company as public corporation on Toronto Stock Exchange
- Negotiated operations contracts

BHP-Billiton, Vancouver/Yellowknife, NWT

1994 - 1997

Manager, Mine Development

Overall responsibility for the permitting, design, construction and operational set up of the \$700million Ekati Diamond Mine in Canada`s Arctic.

- Managed all aspects of mine development
- Lead representative for on panel to obtain mine permits
- Established and executed construction strategy
- Recruiting, hiring, & placing key managers and site operations contractors
- Project built safely, on time and under budget

BHP Billiton, Syama Gold Mine, Mali West Africa

1989 - 1994

Mine Manager

Accountable for the safe operation of the Syama Gold Mine in remote section of Mali

- Exceeded production targets
- Developed and trained local work force
- Increased reserves to extend oxide mine life by two years

BHP Billiton, Queensland, Australia

1987-1989

Mine Engineer/Production Superintendent

Accountable for the Safe Mine Planning and Production supervision of open cast coal mines

- Mine planning for Riverside Coal mine
- Integration of Riverside and Goonyella mines
- Coal Mining Superintendent – Goonyella Mine
- Coal Mining Superintendent – Norwich Park Mine



Daniel Johnson

BHP Billiton US and International

1981 - 1997

Project Engineering and Construction Manager

Accountable Project Engineering and Construction Management services for multitude of development projects for BHP including:

- Design and Construction Management for DTA 25Mtpy coal export terminal; Virginia, USA
- Escondida Copper Mine Project Feasibility Study - Chile
- La Plata Coal Mine – Project Management – New Mexico
- Technical Services for Company's Operations

Tidewater Construction, Virginia/Alabama

1977 - 1979

Construction Engineer

Accountable for the field management, contract management and quality control for large industrial and marine construction projects

- Managed dredging subcontracts
- Planning and QA/QC
- Site Safety Officer

Education and Certificates

- B. Sc. Civil Engineering - Virginia Tech, Blacksburg, Virginia
- MBA - Amos Tuck School of Business, Dartmouth College, Hanover NH
- Virginia and NWT/Nunavut - Registered Professional Engineer (P.E.)

Director & Memberships

Past Director – Wolfden Resources

Past Director – Diamond Fields International

Director – Sigma Alpha Properties LLC

Director/President – The Morley Group



EXPERIENCE SUMMARY

Mr. Horne is a Senior Geotechnical Engineer/Principal Consultant in the Edmonton office. He has over 25 years of experience in geotechnical and permafrost engineering for oil and gas facilities, mining, hydrocarbon, and municipal projects in Northwest Territories, Yukon, Alaska, Alberta, Russia, and the Beaufort Sea. Areas of expertise include industrial plant site development, heavy equipment foundations, water and tailings dam designs, tailings deposition management, geothermal and deformation modelling, and project management.

RELEVANT EXPERIENCE

Mining

- Gahcho Kue Diamond Mine, De Beers Canada, JDS Energy and Mining Inc. – Project Manager for components of a feasibility study. Responsible for waste and water management plan, tailings management, waste rock dumps, and geotechnical design of plant site and civil infrastructure components. The project included an elaborate water management scheme to drain the lakes for three open pits under the lake. A total of 15 dykes were designed to control the water. The project focus was to develop a cost and environmentally effective feasibility plan.
- Jericho Mine, Nunavut, Tahera Diamond Corporation – Principal Engineer for the design and construction of the tailings facility. Dams and dykes were designed to retain fine processed kimberlite tailings. Both frozen core and geomembrane dams were constructed. A tailings management operation guideline document was prepared. A water balance for the tailings facility was developed, along with guidelines for process water discharge.
- EKATI Diamond Mine Processed Kimberlite Facility, NT, BHP Billiton Diamonds Inc. – Senior Project Engineer for the processed kimberlite disposal plan, and dam design and construction. Frozen core dams are used for perimeter containment structures to increase the capacity of the basin. Intermediate filtration dykes are used within the tailings facility. Tender drawings and specifications were prepared. The construction included blasted rock key trenches, frozen placed fill, filters, and rockfill.
- Kubaka Water Dam and Tailings Dam, Magadan Russia, Kinross – Project Engineer for the design and construction of a tailings facility for the Kubaka Gold Mine, Magadan, Russia. A thickened tailings deposition scheme was developed. A water retention dam was constructed downstream of the tailings area. A design brief was

EDUCATION

B.Sc., Civil Engineering,
University of Calgary,
Calgary, AB, 1983

M.Sc., Geotechnical Engineering,
University of Alberta,
Edmonton, AB, 1987

AREA OF EXPERTISE

Geotechnical and Permafrost Engineering, foundation analysis and design, earth dam designs, numerical modelling, and construction drawings and specifications for variety of mining and hydrocarbon projects

Site investigation, foundation and earth embankment designs

**REGISTRATIONS/
AFFILIATIONS**

Member, Association of Professional Engineers and Geoscientists of Alberta (APEGA)

Licensee, Northwest Territories and Nunavut Association of Professional Engineers and Geoscientists (NAPEG)

Member, Canadian Geotechnical Society (CGS)

Member, Geotechnical Society of Edmonton (GSE)

OFFICE

Edmonton, AB

YEARS OF EXPERIENCE

25

CONTACT

Bill.Horne@tetrattech.com

prepared for submission to regulators to obtain permitting. Construction drawings and specifications were developed.

- Polaris Mine, NT, Cominco – Project Engineer for the design of the first frozen core dam in Canada. The dam was for the tailings facility. The thermal behaviour was modelled to evaluate the thermal regime during construction and over the long term. Recommendations for the shore protection and construction materials were provided. A reclamation and abandonment plan was developed.
- Red Dog Mine, Alaska, Cominco – Project Engineer for providing geotechnical input to foundation designs for mill site and port site facilities. Rock socketed piles, spread footings, thrust blocks, and retaining walls were designed. Finite element thermal analyses were carried out to evaluate the performance of a ventilated pad foundation.

Oil and Gas

- Senior Project Engineer for foundations for the Yamal LNG Terminal in Sabetta, Russia. Large diameter pipe piles were used to support LNG Tanks and plant facilities in warm permafrost. Nineteen full size pile load tests were carried out and interpreted to support the foundation design.
- Senior Project Engineer for the foundation design of the Vankor Central Processing Facility, Russia. Foundations were designed for processing modules and pipe racks founded warm permafrost. A combination of steel pipe piles and thermosyphons were used.
- Designed foundations for a diesel generator powerhouse at Arviat, NT. A dynamic analysis was carried out to estimate the natural frequencies and amplitude of vibration of the steel frame generator support base and steel pipe piles.
- Project Engineer for the geotechnical component of an oil and gas field development in Irkutsk, Russia. The area is in a discontinuous permafrost. The feasibility study included pipeline route selection, road alignment and design and foundation designs.
- Designed a refrigerated conductor pipe to prevent permafrost thaw around an exploratory well near Tuktoyaktuk, NWT. Thermal analyses were used to estimate the behaviour of the refrigerated conductor pipe and to predict the zone of thermal disturbance during drilling. A field monitoring program was carried out to evaluate the performance.
- Carried out a laboratory investigation of frozen ice plugs to determine the safety of frozen bentonite plugs for isolating well pressures while the well head is temporarily removed.
- Provided recommendations for artificial ground freezing to stabilize the foundations of pump stations on the Alyeska Pipeline, Alaska. A heated pipeline and pump stations were constructed on ice-rich permafrost in the early 1970s causing permafrost degradation and large settlements over time. To rectify the problem, the ground below the pipelines and structures was refrozen using chilled brine pipes. Finite element thermal analysis was used to predict the rate of freezeback and the heat load from the structures on the cooling plant. The results from the analysis were used to determine the optimum locations of the brine pipes and to size the refrigeration plants.
- Carried out geotechnical analysis for an Offshore Drilling Platform. Skirt penetration depths during setdown and lateral instability due to ice loading were evaluated. Finite element analyses were used to predict the magnitude of deformation during ice loading.
- A liner system was designed to contain the runoff from a large sulphur block at a gas plant. Liner quality assurance and construction supervision services were provided.

Water Retaining Structures

- Responsible for the design and construction of tailings and water retention dams. Projects include Red Dog Mine, Alaska, Polaris Mine, Ekati Diamond Mine, NWT, Kubaka Gold Mine, Russia, and Baley Gold Mine, Russia.
- Designed a frozen core dam for Gjoa Haven, NWT. The dam was used to contain the community's water supply. Design involved thermal analysis, stability analysis and slope protection analysis.
- Involved in preliminary through final design phases of the Oldman River Dam, Pincher Creek, Alberta. The dam is a 75 m high earth fill dam. Input into the design included stability analysis of the embankment, existing slopes and excavated soil and rock slopes and spillway structures, and tunnel portals. Assisted with the preparation of the tender document drawings and specifications.

Foundations

- Project Engineer for providing geotechnical input to foundation designs for mill site and port site facilities at the Red Dog lead zinc mine in Alaska. Rock socketed piles, spread footing, thrust blocks and retaining walls were designed. Finite element thermal analyses were carried out to design a ventilated pad foundation.
- Provided foundation design input to prevent permafrost degradation below a warehouse building in Resolute, NWT. The foundation was analyzed with a two-dimensional finite element thermal program. Heat pipes and insulation were used to provide passive refrigeration, requiring no energy and little maintenance. Drawings and specifications were prepared.
- Designed foundations for a diesel generator powerhouse at Arviat, NWT. A dynamic analysis was carried out to estimate the natural frequencies and amplitude of vibration of the steel frame generator support base and steel pipe piles.

Computer Modelling

- Conducted numerous finite element thermal analyses to model ground temperatures and change in ground temperatures for a variety of projects. Analyses have been carried out to provide designs that prevent either thaw or frost penetration, and for evaluating thermal aspects of subgrade ventilation systems, tailings ponds, dams, and heat pipes.
- Conducted several finite element stress-strain analyses to model foundation behaviour. Analyses have been carried out to calculate displacements for the design of a foundation system for a large covered stadium and to assess the deformation of offshore structures in the Beaufort Sea subjected to ice loading.
- Carried out analyses of laterally loaded piles using a finite difference program to predict pile displacements.
- Incorporated frost heave mechanics into a finite difference thermal program to enable prediction of frost heave magnitudes for various climatic conditions, soil properties and ground water positions.
- Converted EBA's proprietary finite element thermal program "GEOTHERM" from a main frame program to a Macintosh program. Developed a graphical user interface for the program.
- Thaw subsidence analyses were carried out to design a casing for an oil production well through permafrost. The extent of thaw around a single well and well cluster was determined with finite element thermal analysis. Casing stresses and strains resulting from soil thaw strain were estimated using finite element stress analyses.

Geo-environmental and Closure Studies

- Project Manager for the closure and reclamation planning for seven abandoned mines east of Yellowknife, NWT. Geo-environmental sampling was carried out to determine the level of contamination in tailings, soils and lakebed sediments. A remedial action plan and Class I costs estimates were prepared to define the clean-up.
- Project Manager for providing the geotechnical design for the clean-up of 21 DEW Line sites in Yukon, NWT and Nunavut. The designs include remediation of existing landfills, and construction of new landfills. Thermal analyses are used to design frozen containment structures to contain landfill leachate. Geophysics is used to delineate the extent of existing landfills.
- Developed Landfill Design Guidelines for the INAC Contaminated Sites program. The manual included siting criteria, fill material specifications, geomembrane selection, permafrost and thermal considerations and the effects of climate change on landfill designs and risk analysis.
- Project Engineer for a geo-environmental investigation of a gas station to determine the extent of gasoline contamination. Vapour extraction and liquid removal systems were designed and installed to reduce the level of contamination and prevent migration of gasoline and gasoline fumes.
- Project Engineer for a subsurface investigation and geophysical survey to determine the extent of contamination at a car dealership located on the site of a former bulk fuel station. Gasoline vapour measurements and chemical analyses of soil and water samples were carried out to identify the nature and concentration of contaminants. A Ground Penetrating Radar survey was used to identify buried structures and tanks.
- Carried out an investigation for the decommissioning of a truck dealership. The investigation centered around delineating gasoline and diesel contamination from a leaking underground storage tank. Provided project management for the clean-up.
- Evaluated a 30,000 litre oil spill, from a storage tank that was located 30 m from a creek.
- Carried out numerous site pre-acquisition studies to determine site histories and potential geo-environmental hazards on some sites. Boreholes, test trenches and monitoring wells were used to investigate for the presence of contamination. Laboratory analysis of soil samples and water samples was carried out to measure PCB, hydrocarbon, and heavy metal concentrations.

Geotechnical Investigations

- Participated in a site investigation at the Colomac gold mine north of Yellowknife, NWT, using rotary drilling and coring equipment. The investigation results were used to determine the foundation designs for the major structures, airstrip, camp and tank farm.
- Carried out preliminary investigation for a thaw subsidence analysis of production wells through permafrost in Tuktoyaktuk, NWT. The site investigation program used foam drilling techniques, sidewall cores and geophysical logging to determine lithology.
- Planned site investigation for a large earthfill dam. Over 100 drill holes, and four large diameter shafts were drilled to recover core samples, carry out permeability testing and define lithology.
- Carried out a site investigation for an arena and maintenance garage for the community of Whale Cove, NWT. Recommendations for foundations parameters and borrow sources were presented.
- Carried out a site investigation for a powerhouse located in Arviat, NWT. An airtrack drill was used to collect disturbed soil samples. Thermistors were installed to measure the ground temperature.
- A deep permafrost site investigation was carried out in Yamal, Russia and Arkangel, Russia. Continuous coring was used to obtain undisturbed permafrost samples to 300 m below the ground surface. Geophysical logging was used to further identify the lithology, and ice-rich zones. The information was used for a thaw subsidence analysis for oil production wells.

Publications

- Kubaka Mine Tailings Design, Construction and Operation of Frozen Core Dam: A Case Study, ASDSO West Regional Conference 2001.
- DEW Line Landfills, IWCSE 2002 Conference, Edmonton, AB
- Permafrost Containment Landfills at Arctic DEW Line Sites, 56th Canadian Geotechnical Conference, 2003.
- DEW Line Landfill Design and Construction, ASCE Conference, Edmonton, Alberta, 2004.
- Performance Measures of Arctic Landfills, Assessment and Remediation of Contaminated Sites in Arctic and Cold Climates, (ARCSACC), 2005.
- Rationalizing Climate Change for Design of Structures on Permafrost: A Canadian Perspective, Ninth International Conference on Permafrost, Fairbanks, 2008.