Golder Associates Ltd. – Vancouver

Employment History

Education

M.Sc., Hydrogeology, University of Waterloo, Waterloo, Ontario, 1976

B.Sc. (Honours), Geology , University of Alberta, Edmonton, Alberta, 1974

Golder Associates Ltd. – Burnaby, BC
Principal (2003), Senior Hydrogeologist (1986 to Present)

Engaged in hydrogeological investigations throughout North America, Europe, Asia, and South America. Provides senior technical review for hydrogeological aspects of tunnelling, mining and dewatering, water resource management, computer modelling of groundwater flow, design and assessment of groundwater dewatering/depressurization systems.

Independent Consulting Hydrogeologist – Vancouver, BC
Principal (1985 to 1986)

Emphasis on groundwater resource evaluation, groundwater remedial studies, evaluation of proposed mining scenarios, computer modelling of groundwater regimes, and contaminant hydrogeology.

SIMCO Ground Water Research Ltd. – Vancouver, BC
Principal (1980 to 1985)

Emphasis on resource evaluation, environmental assessment, and computer modelling of groundwater flow and mass transport. Responsibilities included management and technical supervision of hydrogeological projects, client representation at environmental hearings, and business development.

Golder Associates Ltd. – Vancouver, BC
Hydrogeologist (1979 to 1980)

Engaged in hydrogeological investigations in mining, geotechnical, and nuclear energy industries.

Alberta Research Council and University of Alberta – Edmonton, AB
Research Hydrogeologist (1973 to 1979)

Provided technical assistance in research projects at the Alberta Research Council and at the University of Alberta. Duties included characterisation of hydrogeological regimes, conducting and analysing pumping tests to assess aquifer properties, numerical modelling of groundwater flow in deep sedimentary basins and coal aquifers and analyses of drill stem tests.

PROJECT EXPERIENCE – GROUNDWATER UNDER TIDAL INFLUENCE

Expo 86 Vancouver, BC	Characterized the soil and groundwater contamination and assessed the groundwater regime and flow conditions under the influence of ocean tides. Conducted numerical modelling of groundwater flow system to assess groundwater remedial measures that accounted for tidal fluctuations. Designed groundwater collection measures and the monitoring required to evaluate the performance of those remedial measures.
Braid Street Site - Former Wood Treatment Facility Coquitlam, BC	Directed groundwater modelling investigations to optimize pump and treat system to capture dissolved phase plume at a wood treatment plant influenced by ocean tides. Designed groundwater remedial measures that incorporated the effects of tidal fluctuations and seasonal changes on groundwater flow.
Oak Street Site Vancouver, BC	Directed groundwater modelling to design groundwater collection system to capture dissolved phase plume and to arrest the movement of DNAPL. The effects of ocean tides and seasonal changes in the Fraser River stage were incorporated into the remedial design.
GVRD (now Metro Vancouver) North Vancouver, BC	Designed dewatering measures, within the delta of the Capilano River, required to prevent uplift in the floor of a Digester during cleaning and to prevent ground settlement at a GVRD water treatment plant. Dewatering measured accounted for ocean tides and changes in river stage.
Ship Yards Vancouver, BC	Directed groundwater modelling investigations to assess remedial options at a shipyard adjacent to Burrard Inlet. The influences of tidal fluctuations and seawater intrusion were incorporated into the model. Modelling was used to optimise the design of the selected remedial option.
Britannia Mine Britannia, BC	Characterised groundwater regime under the influence of ocean tides for the remediation of an orphan gold mine along Howe Sound. Remedial design consisted of pump and treat system that accounted for tidal fluctuations, seasonal precipitation and seawater intrusion.
Metro Vancouver Lower Mainland, BC	Characterised groundwater flow regimes that are under the influence of ocean tides for Water supply beneath the estuary of the Fraser River and Burrard Inlet. Investigations included of installation of monitoring wells equipped with continuous recorders and aquifer testing. Analyses of data to estimate groundwater flow directions, hydraulic gradients and groundwater fluxes to the ocean.
GVRD (now Metro Vancouver) Annacis Island, BC	Developed contractor specifications and reviewed the dewatering plans for installation of permanent flow monitoring station in an area influenced by tidal fluctuations within the estuary of the Fraser River.
Tsawwassen First Nation Delta, BC	Characterised the groundwater regime for an engineered wetland/saltwater marsh along the shoreline of the Pacific Ocean. Design accounted for tidal fluctuations, seawater intrusion and periodic flooding by the ocean.

PROJECT EXPERIENCE – RAINWATER INFILTRATION STUDIES

City of Chilliwack
Chilliwack, BC

Conducted a risk analysis of infiltration of rainwater into aquifer used by the City of Chilliwack for potable water supply. Recommended that infiltration system be installed outside of the capture zone of the aquifer and/or the water supply be chlorinated because of high risk to water quality.

Roadway Infiltration System
Vancouver, BC

Development of practical and field-functional approaches for characterising the soil infiltration potential and hydrogeology for development of roadway rainwater infiltration systems. Development of practical field testing methods for assessing site infiltration potential and to provide input to design matrix of water infiltration systems.

Rainwater Management – Steep Slopes
Coquitlam, BC

Conducted field investigations to evaluate the potential for rainwater infiltration to groundwater at a proposed development along the Coquitlam River. Concluded that the soils provided sufficient infiltration capacity: however, because of slope stability concerns rainwater management required a hybrid system where rainwater is allowed to infiltrate into the groundwater but the rise in the watertable is limited

Integrated Rainwater Management
Delta, BC

Assessment of constraints and opportunities for rainwater infiltration at an industry development on Tsawwassen First Nation lands in Delta, BC. Included the characterization of existing groundwater quality, groundwater levels, permeability, groundwater flow directions and infiltration potential.

Alternative Street Drainage Concept
Burnaby, BC

Senior review of studies to provide hydrogeological input to an alternative street concept recommendations to the City of Burnaby. Investigations were undertaken along a section of each of three City streets, namely Clinton, Carson and Watling. Test pitting and infiltration tests were undertaken at two locations along each of these streets. Criteria were used to select Clinton Street for further investigation. Investigations included drilling of boreholes and installation of monitoring wells to assess the extent of low permeability layer, the location of the watertable and groundwater flow directions.

Gateway Program - South Fraser Perimeter Road Impacts
Delta, BC

Project Director of investigations that characterized existing hydrogeological conditions along portions of a proposed alignment for the South Fraser Perimeter Road. Utilized the baseline information to identify potential impacts to the current groundwater systems and identified mitigative measures for the initial road construction and long-term operational phases.

Regional Aquifer Management
District of Mission, BC

Senior review of studies that provided multi-phase hydrogeological input during development of the District of Mission's Neighbourhood One Plan, including regional-scale characterization of groundwater systems, assessment of potential local and region hydrogeological/aquifer impacts (both quality and quantity) and preparation of an interim Hydrogeology Opportunities and Constraints document. Late stages of program included detailed field testing and analysis to support on-going ISMP design/modelling, in agreement with Metro Vancouver's Template (2005).

Shallow Aquifer Infiltration - Residential Development
Agassiz, BC

Project Director on a project that involved subsurface exploration and testing program to evaluate the potential for direct disposal of rainwater to a shallow unconfined aquifer. Evaluated options for integrating proposed on-site community infiltration gallery with existing municipal piping and surface drainage systems. Proposed residential development within flood-influenced terrain.

Rainwater Infiltration – UniverCity
Burnaby, BC

Senior review of investigations to assess the regional rainwater infiltration to groundwater for residential developments on Burnaby Mountain. Investigations included the installations of shallow wells and undertaking large scale infiltration tests throughout the study area. Modified a technique to determine macro-scale infiltration rates. This methodology has been adapted by Simon Fraser University as the required evaluation method for all developments at Simon Fraser University.

Deep Aquifer Infiltration - Community Planning
Langley, BC

Acted as Project Director for a detailed site exploration and monitoring program for a large, high-density residential subdivision. Provided recommendations for rainwater infiltration using both conventional shallow structures and deep well methods. Conducted in-situ testing of two wells constructed within a deep confined aquifer and estimated the long-term sustainable infiltration rates. Predicted long-term distribution of rainwater within aquifer utilizing a Township-wide numerical model to assess potential impacts of direct aquifer recharge (DAR) using rainwater. Conducted literature review and assisted with development of a commissioned water quality monitoring program.

City of Chilliwack
Chilliwack, BC

Project Director and lead investigator on an assesment of the risk of rainwaiter infiltration in to an alluvial fan that provides drinking water to the city of Chilliwack. Developed recommendations on measures and location of infiltration galleries.

PROJECT EXPERIENCE – HYDROGEOLOGICAL ASPECTS OF TUNNEL AND UNDERGROUND MINE DEVELOPMENT

Seymour-Capilano Filtration Project Twin Tunnels
North Vancouver, BC

Senior technical review of hydrogeological aspects for the design of 7.2-km-long twin water transfer tunnels with three shafts up to 300 m in depth. Responsibilities include planning hydrogeological investigations, carrying out geotechnical analyses and designs, and providing hydrogeological input into the preparation of the Geotechnical Baseline Report (GBR). The geotechnical investigations included almost 4,000 m of drilling in soil and rock, and involved extensive in situ testing hydrogeological testing. Providing on-going review of groundwater conditions during Project operations.

Second Narrows Water Tunnel – Burrard Inlet Crossing - Detailed Design Stage
Vancouver, BC

Hydrogeology for the team carrying out final design and construction supervision for this proposed subsea water tunnel for the Greater Vancouver Water District. Project scope includes hydrogeological investigations and detailed design of shafts in rock and soil (up to 100 m in depth), tunnel design, design for seismic resistance, and preparation of the project Geotechnical Date Report (GDR) and Geotechnical Baseline Report (GBR).

Broadway Transit Project Vancouver, BC	Hydrogeological input for the tunnels for the planned extension to the Greater Vancouver transit system. Golder is the owner's geotechnical engineer for the preliminary design and RFP preparation phase. Input to the planning and execution of the hydrogeological investigations, preparation of the geotechnical preliminary design and preparation of the Geotechnical Date Report (GDR) and Geotechnical Baseline Report (GBR).
Tazi Twe Hydro Project Stony Rapids, Saskatchewan	Hydrogeological input for Golder's team who are carrying out an environmental assessment and detailed design and investigation for the power tunnel (9.1 m dia, 2600 m long) for this proposed 42 MW hydroelectric project. The scope includes hydrogeological investigations, geotechnical and tunnel design, project optimization, risk assessment and assistance in the Early Contractor Involvement (ECI) program.
Port Mann Water Supply Tunnel Coquitlam and Surrey, BC	Lead Hydrogeologist for the construction stage of this1 km long, 3.6 m diameter tunnel with twin 80 m deep shafts for this expansion to the Greater Vancouver water supply system. Responsible for overseeing the final stage hydrogeological investigations, support to the preparation of the RFP documents, support to preparation of the Geotechnical Date Report (GDR) and Geotechnical Baseline Report (GBR).
BC Hydro John Hart Project Campbell River, BC	Acted as senior technical review of the hydrogeological aspects of the John Hart penstock replacement project. Project consisted of replacing an above ground penstock with a 1.2 kilometre tunnel. It consisted of an assessment of groundwater inflows during construction and outflow during operations and potential effects to nearby slopes and a water retention dam. Assisted with the development of Specifications and Geotechnical Baseline Report.
Washington State Department of Transport, Alaska Way Replacement Project Seattle, Washington, USA	Hydrogeological lead acting for the State to assess technical aspects of the tunnel to replace the Alaska Way viaduct. Review claims for damage and provide opinions on the effects of the project on groundwater resources and land settlement. Act as expert witness if this is found to be necessary.
Evergreen ALRT (Skytrain) Tunnels Port Moody and Coquitlam	Senior technical review of hydrogeological aspects for the 2 km long, 10 m diameter single bore tunnel for this extension to the Greater Vancouver transit system. Golder was the owner's geotechnical engineer for the preliminary design and RFP preparation phase. Oversaw the planning and execution of the hydrogeological investigations and provided hydrogeological input in the preparation of the geotechnical preliminary design and preparation of the GBR and GDR.
Greenhills SE British Columbia	Developed a numerical model of an open pit coal mine to predict pore pressures in the pit slopes and to assess dewatering options. Assisted in the design of deep dewatering wells to lower the pressures in the pit walls to acceptable levels for slope stability.

La Colorada Mexico	Undertook hydrogeological investigations in an underground silver mine. Testing included pumping tests and measurement of hydraulic heads in probe holes. A numerical hydrogeological model was developed to predict future mine inflows and to assess dewatering options.
Meliadine Nunavut	Hydrogeological Lead in the Environmental Assessment for several open pits and one underground mine for mining of gold deposits near Rankin Inlet. Included characterization of groundwater for baseline environmental conditions, estimate of groundwater inflow quantity and quality and development of effects assessment.
BC Hydro John Hart Project Campbell River, BC	Acted as senior technical review of the hydrogeological aspects of the John Hart penstock replacement project. Project consisted of replacing an above ground penstock with a 1.2 kilometre tunnel. It consisted of an assessment of groundwater inflows during construction and outflow during operations and potential effects to nearby slopes and a water retention dam. Assisted with the development of Specifications and Geotechnical Baseline Report.
Kiggavik Nunavut	Assessed groundwater inflows and preliminary depressurization measures to a proposed underground mine beneath permafrost in Nunavut. Included hydrogeological testing and numerical modelling for feasibility and baseline studies.
Metro Vancouver North Vancouver, BC	Senior technical review of the hydrogeological aspects of the Seymour Capilano Filtration Project (SCFP). Project consisted of the installation of twin tunnels, 7 km in length, in bedrock between the Capilano Dam and the Seymour River drainage for the conveyance of raw and treated water. Estmated groundwater inflow quantities during excavation of the tunnels and groundwater outflow and cross-flow between tunnels when at full operating pressures. Assessed the potential effects to seepage and slope stability to the East Abutment of the Cleveland Dam and the west slope of Lynn Creek during construction and operations of the twin tunnels.
Roughrider Saskatchewan	Senior technical lead on an underground uranium mine in northern Saskatchewan. Work included development of baseline groundwater assessment based on permeability testing and development of a numerical hydrogeological model to simulate of Life of Mine groundwater inflow estimates for Order of Magnitude and Prefeasibility studies.
Teck Corporation Alaska	Conducted studies to estimate mine inflow and to assess dewatering and grouting strategies at a proposed underground mine. Included packer testing, installation of monitoring wells, water sampling, pumping tests and numerical modelling. Designed wells for the injection of treated mine water during the development of exploration decline. Providing on-going hydrogeological assessment for full mine development.
Giant Mine Northwest Territories	Conducted hydrogeological investigations related to an existing and a recently excavated arsenic stope. Conducted permeability testing and hydraulic head measurements in the pillar between stopes. Recommended the installation of a drainage galley beneath the two stopes to promote dewatering of the stopes. Drainage galley was nearing completion when the mine was shut-down.

Winspear Northwest Territories	Provide hydrogeological services to the EIS and Feasibility mine plan. Investigations have included the installation of piezometers, permeability testing and water sampling. Computer modelling was undertaken to estimate mine inflows during the exploration decline and at the planned full mine development.
Pend Oreille Washington	Hydrogeological investigations related to mine expansion. Investigations included permeability testing and hydraulic head measurement of proposed shaft development. Computer modelling was undertaken to estimate inflows to shaft development. Provide recommendations on mine dewatering strategies and grouting procedures.
Turquoise Ridge Nevada	Hydrogeological investigations to develop dewatering strategies to improve trafficability in production areas. Included 3-D visualization of underground development, geology, structure and measurements of groundwater inflow during drilling of long exploration holes. The structure and geology were correlated to high inflows in order to identify major groundwater pathways that can be intercepted and drained prior to mining.
Asia Pacific Thailand	Conducted pre-feasibility and feasibility hydrogeological investigations of a proposed underground potash mine. Including pumping tests, installation of monitoring wells, water sampling and numerical modelling. Estimated mine inflows and water supply potential and provided conceptual dewatering strategies.
Polaris Mine Cornwallis, NWT	Provided testing procedures to determine hydrogeological properties at a proposed underground mine expansion. Numerical modelling was conducted to assess mine inflow at a planned expansion.
Raglan Northern Quebec	Undertook and groundwater benchmark study that examined potential groundwater issues that could result if underground mining progressed below the permafrost zone. The quantity of inflow to this mine was of a particular concern as the ventilation in the underground is not heated. All previous mining was within the permafrost. Studies included review of thermal regime data, groundwater inflows to boreholes drilled below the permafrost, regional water level elevations of large lakes in area, geology and hydrogeologic projects with similar hydrogeologic and thermal regimes.
Red Mountain Smithers, BC	Conducted hydrogeological investigations to assess hydrogeological conditions and to estimate mine inflows to proposed underground mine.
Westmin Resources Myra Creek, BC	Characterised the groundwater regime and determined the source of acid rock drainage. Investigation included installation of wells, permeability testing and water sampling. Assisted in the design of remedial measures.
Uranium Mine Northern Saskatchewan	Developed a computer model of the groundwater regime at a proposed underground uranium mine. Analyses included assessment of mine inflows to various proposed mine plans and the effect of grouting and/or dewatering on mine inflow and water pressures.

Potash Mine Esterhazy, SK	Model analysis of groundwater regime to determine approximate location and chronology of leaks at an underground potash mine. Included analyses of several hundred drill stem tests to determine formation transmissivities and numerical modelling.
Hudson Bay Mining and Smelting Manitoba	A study to estimate groundwater inflow and recommend dewatering strategies in underground mines at Photo Lake and Kunoto Lake.
Eldorado Gold Corporation Turkey	A study to estimate groundwater inflow to a proposed underground mine and to assess the effects of mining on the groundwater and surface water regime.
Homestake British Columbia	Hydrogeological study including pumping tests, inflow mapping, structural modelling and packer testing. Groundwater inflow was estimated for the life of the mine. Dewatering wells were designed and installed. Dewatering strategies were determined.
Snap Lake Northwest Territories	Provided technical assistance on hydrogeology components of an environmental assessment and in hearings relate to project approvals and permitting. Included characterization of the regional groundwater flow regime and the prediction of the direction, travel time and contaminant transport of dissolved metals originating from the mine following closure of the mine. The environmental assessment was approved in late 2003.
Hydro-Power Generation Revelstoke, BC	Groundwater investigations to assess potential groundwater leakage from a small-scale hydro-electric project. Investigations have included hydro-jacking testing, permeability testing, mapping and measurement of underground inflows and computer modelling to assess potential water leakage from the project during operation.
TVX Gold Eastern Europe	Assessment of groundwater inflow to a proposed underground mine. Included the development of a computer model that was calibrated to measured inflows to preliminary mine development.
Diavik Diamond Project Northwest Territories	Providing ongoing hydrogeological investigations to determine groundwater inflows to a mine located near Yellowknife. Duties have included conducting permeability tests in deep exploratory boreholes and conducting pumping tests in the underground mine. Numerical hydrogeological modelling was undertaken to assess mine inflows, dewatering systems, dewatering strategies and remedial measures. Drainage galleries consisting of 4 to 6 drainholes were designed and installed at approximately 75 m depth intervals in the underground mine. Acted as expert witness during project approval process.
Jullietta Former U.S.S.R	Groundwater investigations at a proposed underground mine to assess groundwater inflows. Groundwater model was developed and calibrated to inflows to advanced exploration program.
T'Sable River BC	Groundwater investigations to assess groundwater inflows to an exploration decline. Investigations included flow meter testing, permeability testing, piezometer installation and computer modelling. The potential for saline water intrusion will be assessed.

PROJECT EXPERIENCE – HYDROGEOLOGICAL ASPECTS OF WETLANDS

Timberwest Mt. Washington, BC	Provided hydrogeological review of proposed mine discharge renovation measures using natural and engineered wetlands. Treatment included enhancement of exiting wetlands and construction of engineered wetlands. Presented to government regulatory agencies including DFO and Ministry of Environment.
First Nations Anahim Lake, BC	Involved in hydrogeological investigations of a natural wetland for final renovation of sewage from a First Nations village. Investigations included installation of monitoring wells, identification of separate hydrogeologic layers within the wetland, permeability testing of the peat and underlying soil layers. Analyses identified groundwater flow directions and velocities.
Cominco Pine Point, BC	Involved a hydrogeological evaluation of a natural wetland for treatment of discharge from a mine tailings pond. Involved estimates of wetland capacity and assistance with design and enhancement of the wetland.
Ministry of Transport and Infrastructure Delta, BC	Acted as senior technical review of hydrogeological aspects of the alignment of the South Fraser Perimeter Road near the west and north boundaries of Burns Bog. Included the installation of monitoring wells within the bog, identification of the various bog layers and water chemistry, water level monitoring, water sampling and permeability testing of the bog layers and underlying soils. Provided a qualified hydrogeological resource to the Ministry and presented on the hydrogeology of Burns Bog to government agencies, academic institutes and the public.

PROJECT EXPERIENCE – LANDFILL INVESTIGATIONS

Wildwood Landfill Powell River, BC	Provided senior technical review of groundwater monitoring program for a landfill that receives waste from the mill site. Activities include streamlining of monitoring well network, installation of recovery wells, and enhancement of collection system.
Hartland Landfill Victoria, BC	Responsible for hydrogeologic component of a review of the environmental monitoring systems at the Hartland Landfill. Identified potential reductions in the number of groundwater monitoring wells.
Crofton Landfill Crofton, BC	Provided senior technical review of hydrogeologic investigations of a proposed expansion of a wood ash landfill. Investigations included borehole and monitoring wells to assess groundwater flow directions and velocities. Evaluated potential impacts to nearby groundwater and surface water supplies.
Premier Landfill North Vancouver, BC	Designed leachate collection that included horizontal drains, sumps, and pumping system. Designed monitoring well network to assess leachate collection efficiency.

Harmac Landfill Nanaimo, BC	Provided senior technical review for an assessment of hydrogeological conditions at an existing landfill that receives woodwaste and pulp mill sludge and at a planned landfill expansion. Investigations included drilling of boreholes, packer testing, and installation of monitoring wells.
Vancouver Landfill Delta, BC	Carried out hydrogeological investigations to determine optimum locations for wells to monitor the performance of collection system. Investigations included drilling and installation of monitoring wells.
Cheam First Nation Landfill Agassiz, BC	Assessed hydrogeological conditions including existing groundwater flow directions, groundwater velocities, and water chemistry. Set up numerical model to assess potential future groundwater flow conditions and leachate migration. Provided recommendations on the location of wells and chemical parameters for future monitoring.
Former Coquitlam Landfill Coquitlam, BC	Conducted hydrogeological investigations related to closeout planning and environmental risk assessment of a former demolition debris and fly ash landfill in Coquitlam. Investigations included shallow monitoring wells and water quality sampling.

PROJECT EXPERIENCE – GROUNDWATER RESOURCE DEVELOPMENT

Subdivision Bowen Island, BC	Acted as Senior Technical Review for groundwater resource evaluation for a subdivision on Bowen Island. Undertook installation of wells and conducted pumping tests to assess yield and water samples to assess water quality.
Village of Pemberton Water Supply Pemberton, BC	Acted as Senior Technical review for groundwater supply options for the Village of Pemberton and provided recommendations for exploring and developing water supply wells within three areas identified as potential source sites. Completed an exploration program to characterize and evaluate the potential for constructing additional supply wells in the aquifer hosting existing Village Wells.
Groundwater Modelling Study Township of Langley, BC	Project Director and Senior Technical review for a comprehensive groundwater modelling study for the Township of Langley. The project consisted of assembly and review of available information concerning the Township's geology, hydrology, and hydrogeology, the development of three-dimensional conceptual model of groundwater flow within the Township, and the construction and calibration of a three-dimensional numerical groundwater model. The model was used to delineate capture zones for municipal wells and to assess the water balance for the Township.
Halfway Band Fort St. John, BC	Conducted exploratory drilling to determine optimum location of water supply well for the Halfway Band. Included installation of production well and pumping tests to assess long-term yield. Study included well installation, pumping tests, and groundwater yield evaluation.
Tsawwassen First Nation Tsawwassen, BC	Acted as Project Hydrogeologist in a groundwater resource evaluation investigation. Consisted of the installation of wells and pumping tests. Identified potential source areas for groundwater.

Stoney Creek Band Vanderhoof, BC	Installed water supply well for the Stoney Creek Band as part of a village expansion. Study included well installation, pumping tests, and groundwater yield evaluation.
Blueberry Band Fort St. John, BC	Assessed groundwater yield at existing well for the Blueberry Band and installed a back-up well.
White Bear Band Regina, SK	Assessed groundwater resources at the White Bear Reserve in east central Saskatchewan. Included pumping tests and exploratory drilling to evaluate groundwater resource potential.
Burnaby Golf Course Burnaby, BC	Assessed groundwater supply potential for irrigation water for a golf course. Study included a test well drilling program.
D.L. 749 Massett, BC	Evaluated groundwater supply for a community expansion on the Queen Charlotte Islands for the Massett Band. Included review of wells in the vicinity and exploratory drilling.
Spring Water Bottling Company Revelstoke, BC	Acted as project manager of groundwater investigations to increase groundwater yields and to provide secure groundwater supply to a spring water bottling company. Included drilling of horizontal wells to provide a secure water quality supply, assessment of total potential yield, and design and construction of structure to protect natural springs. In addition, assisted with regulatory process for approval of spring water with US federal agencies.
City of Chilliwack Chilliwack, BC	Assessed the long-term yield of an existing well field and evaluated alternative sources of groundwater supply at Sardis. Provided technical review on the installation of monitoring wells and monitoring of water chemistry.
Groundwater Protection Plan Chilliwack, BC	Developed a groundwater protection plan for the District of Chilliwack. Work consisted of capture zone analysis, vulnerability mapping, and a contaminant inventory. Based on the results, developed recommendations for groundwater protection measures, along with groundwater monitoring and contingency plans.
Whistler Mountain Whistler, BC	Installed a well field in bedrock at a restaurant near the top of Whistler Mountain. Carried out exploratory drilling to determine optimum well location. Evaluated long-term sustained yield from groundwater for the well field and a separate well located at the Olympic Station.
Mount Washington Courtenay, BC	Assessed groundwater supply from springs and the potential for groundwater supply from a well field. Study consisted of geophysical surveys, well installation and aquifer testing program.
Newmont Gold Company Indonesia	Assessed groundwater potential at a proposed port facility and for the village of Tonga on the island of Sumbawa in Indonesia.
Review of Groundwater Protection Practices British Columbia	Acted as senior review of non-regulatory groundwater protection practices in western developed nations on behalf of Environment Canada. Evaluated the strengths and weaknesses of the various approaches, and recommended strategies for potential application to the Fraser River Basin to complement proposed provincial groundwater legislation.

Subdivision Whitehorse, YT	Conducted exploratory drilling and pumping tests to assess the groundwater resources at a proposed subdivision near Whitehorse.
Groundwater Resource Mapping Edmonton, AB	Conducted and analysed pumping tests to assess groundwater resources in the vicinity of the City of Edmonton.
Well Rehabilitation Kamloops, BC	Evaluated the yields from wells at a Youth Detention Centre. Recommended well rehabilitation and long-term treatment measures to prevent reduction in yields in the future.
Assessment of Highway Construction Impacts on Existing Water Wells Qualicum, BC	Conducted an investigation of existing groundwater and surface water supplies along the proposed alignment of the Inland Island Highway on behalf of the Ministry of Environment to assess the potential affect of highway construction. The study involved a preliminary survey of existing water wells and surface water licenses followed by pumping testing and water quality analysis.
Research Council of Alberta Alberta	Assisted in the aquifer testing program conducted in Alberta. Included instruction of drilling and pumping test contractors, analyses of aquifer tests, and development of database for hydraulic parameters derived from the tests.
Aquifer Testing Lower Mainland, BC	Conducted testing of domestic wells to assess groundwater yield and groundwater quality for subdivision certification purposes.

PROJECT EXPERIENCE – CREOSOTE/COAL TAR SITES

Expo 86 Vancouver, BC	Characterized the soil and groundwater contamination and assessed the groundwater regime and flow conditions. Conducted numerical modelling of groundwater flow system to assess groundwater remedial measures. Designed groundwater collection measures and the monitoring required to evaluate the performance of those remedial measures.
Braid Street Site - Former Wood Treatment Facility Coquitlam, BC	Directed groundwater modelling investigations to optimize pump and treat system to capture dissolved phase plume at a wood treatment plant influenced by ocean tides. Designed groundwater remedial measures that incorporated the effects of tidal fluctuations and seasonal changes on groundwater flow.
Oak Street Site Vancouver, BC	Directed groundwater modelling to design groundwater collection system to capture dissolved phase plume and to arrest the movement of DNAPL. The effects of ocean tides and seasonal changes in river stage were incorporated into the remedial design.
Former Lumber Mill Esquimalt, BC	Assessed the groundwater regime and contaminant plume consisting of elevated levels of chlorophenols at a former lumber mill. Modelled the groundwater regime and assessed the efficiency of various groundwater collection measures. Designed collection wells and evaluated the proposed close-out procedures.
Meadow Avenue Site – Former Wood Preserving Facility Burnaby, BC	Senior technical review of modelling to assess groundwater and NAPL remedial measures. The effects of tidal fluctuations and seasonal changes on groundwater flow conditions were included in the remedial design.

Former Coal Gasification Plant
Vancouver, BC

Conducted computer modelling to assess remedial measures at a former coal gasification plant. Designed groundwater collection measures and evaluated the long-term groundwater chemistry for treatment design.

BC Hydro
Vancouver, BC

Characterized the groundwater, soil, and NAPL contamination at a substation. Contamination originated from a former coal gasification plant located on adjacent property

PROJECT EXPERIENCE – GROUNDWATER DEWATERING AND SEEPAGE ANALYSIS

Greenhills
SE British Columbia

Developed a numerical model of an open pit coal mine to predict pore pressures in the pit slopes and to assess dewatering options. Assisted in the design of deep dewatering wells to lower the pressures in the pit walls to acceptable levels for slope stability.

La Colorada
Mexico

Undertook hydrogeological investigations in an underground silver mine. Testing included pumping tests and measurement of hydraulic heads in probe holes. A numerical hydrogeological model was developed to predict future mine inflows and to assess dewatering options.

Translink
Lower Mainland, BC

Acted as senior technical review of the hydrogeological aspects of the Evergreen rapid transit line. Project consisted of characterization of groundwater regime in the tunnel portion of the rapid transit line. Instrumental in developing the hydrogeological aspects of the Geotechnical Baseline Report and Project Specifications.

BC Hydro John Hart Project
Campbell River, BC

Acted as senior technical review of the hydrogeological aspects of the John Hart penstock replacement project. Project consisted of replacing on ground penstock with a 1.2 kilometer tunnel. It consisted of an assessment of groundwater inflows during construction and outflow during operations and potential effects to nearby slopes and dam. Assisted with the development of Specifications and Geotechnical Baseline Report.

TransCanada Highway
Revelstoke, BC

Groundwater investigations to assess the design of drainage galleries for slope stability purposed on TransCanada Highway. Investigations included installation of piezometers, groundwater modelling to assess optimum location of drainage tunnels and assistance in the design of the tunnels and drains.

Metro Vancouver
Coquitlam, BC

Senior technical review of hydrogeological aspects of an excavation for the Coquitlam UV facility on the Coquitlam River. Included instrumentation, hydrogeological testing and numerical modelling to assess excavation slope stability and dewatering requirements. Provided preliminary design of dewatering system for technical specifications.

Endako Mines
Prince George, BC

Hydrogeological testing and instrumentation to evaluate current water pressures in the walls of an open pit mine and to predict future water pressures. Developed remedial measures consisting of horizontal drainholes to improve slope stability conditions.

Huckleberry Mines Smithers, BC	Involved in the hydrogeological assessment of a proposed open pit expansion that would intersect a historical tailings disposal areas. Involved in the design of dewatering/depressurization systems to assist in the stabilization of the pit slopes. Included hydrogeological testing and the development of a numerical model.
Ivanhoe Mines Mongolia	Senior technical review of hydrogeological aspects of the Oyu Tolgoi Project. Developed numerical hydrogeological model to predict seepage into a proposed open pit and to predict hydraulic heads to assess future slope stability conditions in the pit walls. Assisted in the preliminary design of dewatering/depressurization systems to improve slope stability.
Diavik Diamond Mine Lac De Gras, NT	Senior technical review of the hydrogeological aspects of an open pit mine. Included the instrumentation and hydrogeological testing of pit slopes to evaluate the current slope stability and groundwater seepage conditions and to predict future conditions. Where required, developed dewatering/depressurization methods to improve stability of the slopes. Providing on-going suppport to dewater design and the underground mine.
Metro Vancouver North Vancouver, BC	Senior technical review of the hydrogeological aspects of the Seymour Capilano Filtration Project (SCFP). Project consisted of the installation of twin tunnels, 7 km in length, in bedrock between the Capilano Dam and the Seymour River drainage for the conveyance of raw and treated water. Estimated groundwater inflow quantities during excavation of the tunnels and groundwater outflow and cross-flow between tunnels when at full operating pressures. Assessed the potential effects to seepage and slope stability to the East Abutment of the Cleveland Dam and the west slope of Lynn Creek during construction and operations of the twin tunnels.
GVRD North Vancouver, BC	Designed dewatering measures required to prevent uplift in the floor of a Digester during cleaning and to prevent ground settlement at a GVRD water treatment plant.
BC Hydro Castlegar, BC	Designed and provided specifications for a drain collection system for slope stability of dam abutments at the Kootenay Canal Power Plant. Specified pre-packed screens to drain a silt slope.
Highland Valley Copper Kamloops, BC	Provided on-going monitoring and evaluation of dewatering program at an open pit mine. There are two components to the dewatering program – deep high capacity wells to dewater highly permeable alluvial fans and vacuum assisted low capacity wells to depressurize silt and clays for slope stability purposes.
Newmont Gold Company Indonesia	Assessed the dewatering requirements and the effects of dewatering, pit lake formation, and waste rock on groundwater and surface waters.
Cominco Ltd. Smithers, BC	Evaluated the groundwater inflows and groundwater pressures resulting from proposed remedial measures at closure of an open pit.
GVRD Annacis Island, BC	Developed contractor specifications and reviewed the dewatering plans for installation of permanent flow monitoring stations.

Armenonic Ecuador	Assessed the existing tailings pond dam and proposed additions. Included recommendations for monitoring and stability improvements.
Cominco Ltd. Pine Point, NT	Conducted computer modelling of the groundwater regime. Assessed dewatering schedule and procedures. Included training of mine staff in model utilisation
PetroCanada Ltd. Chetwynd, BC	Modelled the groundwater flow regime at a proposed open pit mine to assess groundwater inflow and dewatering requirements.
Westmin Resources Myra Creek, BC	Characterised the groundwater regime and determined the source of acid rock drainage. Assisted in the design of remedial measures
Fording Coal Elkford, BC	Assessed the tailings dam leakage and designed a leakage retrieval system.
Effects of Open Pit Mine on Groundwater Supply Fife Lake, SK	Evaluated the impacts of an open pit coal mine in Southern Saskatchewan on the quality and quantity of groundwater at a nearby town.
Polygon Development Coquitlam, BC	Assessed excavation inflows at a condominium development, designed the underdrain and the dewatering plan for excavation.
Mine Decommissioning Whitehorse, YT	Developed computer models to assess groundwater flow following decommissioning of an underground mine. Included evaluation of changes in groundwater discharge volumes as a result of decommissioning of mine tailings and rock waste dump.
Tar Sands Development Fort McMurray, AB	Assessed the groundwater regime at a proposed tar sands development in Northern Alberta. Included computer model to estimate mine inflow and to develop mine dewatering strategies.
Uranium Mine Northern Saskatchewan	Developed computer model of groundwater regime at a proposed underground uranium mine. Analyses included assessment of mine inflows to various mine works scenarios and the effect of grouting on mine inflow and water pressures.
Open Pit Coal Mine Wabamum Lake, AB	Modelled the groundwater regime at a open pit coal mine to evaluate the impact of the mine on the regional groundwater system and supply.
Coal Washing Reservoir Gravelbourg, SK	Characterised the groundwater regime beneath a proposed coal washing reservoir. Included computer model analysis to determine the effect of high water levels in lagoon on the regional groundwater flow system and on groundwater supply.
Potash Mine Esterhazy, SK	Carried out model analysis of groundwater regime to determine approximate location and chronology of leaks at a potash mine. Included analysis of several hundred drill stem tests to determine formation transmissivities.
Coal Aquifers Alberta	Conducted a study to characterise the hydraulic parameters of coal aquifers in Alberta. Included analyses of hundreds of pumping tests to determine effect of fracturing on transmissivity and storativity of coal seams.

PROJECT EXPERIENCE – GROUNDWATER REMEDIAL STUDIES AND ENVIRONMENTAL ASSESSMENTS

Diavik Diamond Project NWT	Providing on-going hydrogeological investigations to determine groundwater inflows to a mine located near Yellowknife. Duties included conducting permeability tests in deep exploratory boreholes, design of deep groundwater sampling device, conducting a pumping test in an exploratory decline, and modelling to assess mine inflows, dewatering systems and strategies, and remedial measures. Acted as expert witness during project approval process.
Former Metal Tube Manufacturer Annacis Island, BC	Characterised the groundwater flow, contaminant transport, and NAPLs migration. Chemicals of concern included metals, PCBs, and volatile organic compounds. Designed groundwater contaminant remedial measures.
Expo '86 Vancouver, BC	Characterised the soil and groundwater contamination and assessed the groundwater regime and flow conditions. Conducted numerical modelling of groundwater flow system to assess groundwater remedial measures. Designed groundwater collection measures and the monitoring required to evaluate the performance of those remedial measures.
Ship Yards Vancouver, BC	Directed groundwater modelling investigations to assess remedial options at a shipyard adjacent to Burrard Inlet. The influences of tidal fluctuations and seawater intrusion were incorporated into the model. Modelling was used to optimise the design of the selected remedial option.
Premier Landfill North Vancouver, BC	Designed a leachate collection system and long-term monitoring system to assess leachate collection efficiency.
Braid Street Site – Former Wood Treatment Facility Coquitlam, BC	Directed groundwater modelling investigations to optimise pump and treat system to capture dissolved phase plume at a wood treatment plant influenced by ocean tides. Designed groundwater remedial measures that incorporated the effects of tidal fluctuations and seasonal changes on groundwater flow.
Chemical Plant Delta, BC	Characterised the groundwater flow regime and contamination beneath a former chemical plant. Conducted numerical modelling to assess various remedial action measures and the design of groundwater remedial measures.
Pinetree Golf Course Delta, BC	Characterised the groundwater regime and conducted computer modelling to evaluate the effect of a proposed golf course on the groundwater flow conditions.
Oak Street Site Vancouver, BC	Directed groundwater modelling to design groundwater collection system to capture dissolved phase plume and to arrest the movement of DNAPL. The effects of ocean tides and seasonal changes in river stage were incorporated into the remedial design.
Former Lumber Mill Esquimalt, BC	Assessed the groundwater regime and contaminant plume consisting of elevated levels of chlorophenols at a former lumber mill. Modelled the groundwater regime and assessed the efficiency of various groundwater collection measures. Designed collection wells and evaluated the proposed close-out procedures.
Bell Pole Ltd. Lumby, BC	Conducted stochastic computer modelling for the development of risk-based and site-specific remediation criteria. Evaluated the groundwater regime and contaminant transport at a former telephone pole dipping facility.

Meadow Avenue Site – Former Wood Preserving Facility Burnaby, BC	Provided senior technical review of modelling to assess groundwater and NAPL remedial measures. The effects of tidal fluctuations and seasonal changes on groundwater flow conditions were included in the remedial design.
Former Coal Gasification Plant Vancouver, BC	Conducted computer modelling to assess remedial measures at a former coal gasification plant. Designed groundwater collection measures and evaluated the long-term groundwater chemistry for treatment design.
BC Hydro Vancouver, BC	Characterised the groundwater, soil, and NAPL contamination at a substation. Contamination originated from a former coal gasification plant located on adjacent property.
Newmont Gold Company Indonesia	Characterised groundwater flow regime and chemistry at a proposed mine site. Conducted numerical modelling to assess affect of mine development on groundwater chemistry, surface water chemistry, and on the groundwater flow conditions.
Jet Fuel Tank Farm Richmond, BC	Characterised contamination beneath a jet fuel farm. Designed remedial measures to remove and control contaminants in subsurface.
Mine Remediation and Expansion Myra Creek, BC	Characterised groundwater regime and groundwater contamination at a mine on northern Vancouver Island. Determined the source of acid rock drainage. Assisted in the design of remedial measures
Whonnock Lumber Haney, BC	Conducted drilling and well installation program. Characterised groundwater contaminant plume consisting of chlorophenols. Developed remedial measures.
Government of Saskatchewan Fife Lake, SK	Evaluated environmental impacts of an open pit coal mine on the quality and quantity of groundwater at a nearby town. Consisted of well survey and collection of water samples over several years to determine the groundwater flow conditions and temporal changes in water chemistry.
City of Vernon Vernon, BC	Conducted groundwater modelling of a proposed waste disposal site to determine if it was sufficiently isolated from surface water bodies.
Whitehorse Copper Ltd. Whitehorse, YT	Carried out environmental impact assessment of a former mine site. Included modelling to assess groundwater flow conditions following mine decommissioning and close-out.
Arctic and Sub-Arctic Northern Canada	Assessed the environmental impact of various drilling mud disposal methods in the Canadian Arctic and Sub-Arctic.
Brine Storage Pond Drumheller, AB	Conducted groundwater field investigations of a proposed brine storage pond in Southern Alberta. Included evaluation of soil hydraulic conductivity and groundwater flow regime.
Alberta Environment Lethbridge, AB	Characterised the groundwater regime and flow conditions at the Blood Indian Reserve in Alberta. Included model studies of the impact on the groundwater system resulting from irrigation and the potential for soil salinization.

PROJECT EXPERIENCE – COMPUTER MODEL CODE DEVELOPMENT AND ASSESSMENT

Groundwater Transport Model, Ministry of Environment British Columbia	Developed groundwater transport model that simulates the movement of a contaminant from the soil to the groundwater and the movement of the groundwater contaminant to the receptor. Model is used to develop site-specific standards under the Contaminated Sites Regulation (CSR) for British Columbia.
Stochastic Contaminant Model, Bell Pole British Columbia	Developed a stochastic model to determine risk-based remediation criteria at a former wood treatment facility.
Multiaquifer Systems, University of Waterloo Ontario	Developed a finite element model for analysis of multi-aquifer systems. Included development of analytical and one-dimensional models to represent vertical flow through aquitards.
Fracture System, University of British Columbia Vancouver, BC	Developed a computer model for randomly selected three-dimensional fracture systems.
Evaluation of Groundwater Flow and Chemistry Models, University of Alberta Edmonton, AB	Provided an inventory of available groundwater flow and chemistry models and the potential applications of the models.

PROJECT EXPERIENCE – HYDROLOGICAL ASPECTS OF ENVIRONMENTAL ASSESSMENTS AND PERMITTING

BC Hydro John Hart Project Campbell River, BC	Acted as senior technical review of the hydrogeological aspects of the John Hart penstock replacement project. Project consisted of replacing an above ground penstock with a 1.2 kilometre tunnel. Included an assessment of groundwater inflows during construction and outflow during operations and potential effects to nearby slopes and dam. Assisted with the development of Specifications and Geotechnical Baseline Report and Groundwater Section of an Environmental Assessment.
Diavik Diamond Project Northwest Territories	Providing on-going hydrogeological investigations to determine groundwater inflows to a mine located near Yellowknife. Duties have included conducting permeability tests in deep exploratory boreholes and conducting pumping tests in the underground mine. Numerical hydrogeological modelling was undertaken to assess mine inflows, dewatering systems, dewatering strategies and remedial measures. Drainage galleries consisting of 4 to 6 drainholes were designed and installed at approximately 75 m depth intervals in the underground mine. Acted as expert witness during project approval process and water licence renewal.

Meliadine Nunavut	Hydrogeological Lead in the Environmental Assessment for several open pits and one underground mine for mining of gold deposits near Baker Lake. Included characterization of groundwater for baseline environmental conditions and development of effects assessment.
Turnbull Elkford, BC	Hydrogeological Assessment for permitting of groundwater flow and quality from proposed tailings storage within an open pit coal mine. Included prediction of groundwater flow paths and groundwater quantity and quality.
McNab Cr. British Columbia	Hydrogeological Lead in an Environmental Assessment for an aggregate extraction project in Howe Sound. Included characterization of the groundwater regime and effects assessment of the project and assessment of measures to mitigate effects to freshwater aquatic habitat.
Gahcho Kue Gahcho Kue	Hydrogeological Lead in an Environmental Assessment for a diamond mine. Included the development of characterization of groundwater regime for baseline conditions and numerical modelling to assess environmental effects. Options were examined to mitigate effects to the environment. Acted as Expert Witness at MacKenzie Valley Environmental Impact Review Board hearings.
Meadowbank Nunavut	Hydrogeological Lead in the Environmental Assessment for open pit mines installed in a former lake bottom. Included characterization of the baseline groundwater quality and quantity and numerical hydrogeological model to assess potential effects to groundwater and other values ecosystem components.

PROJECT EXPERIENCE – HYDROGEOLOGICAL ASPECTS OF OPEN PIT MINE DEVELOPMENT

Rea Gold Company Uruguay	Characterised the groundwater regime prior to mine development. Numerical modelling was conducted to assess mine inflows and depressurisation for slope stability purposes and the potential impacts of mine development of nearby surface water and groundwater supply.
Highland Valley Copper Kamloops, BC	Provided on-going monitoring, evaluation, and design of dewatering program for slope stability purposes at an open pit mine in south-central British Columbia. Presently, the dewatering system pumps a total of over 28,000 m3/day from overburden materials. Modelling conducted to assess future dewatering requirements.

Newmont Gold Company Batu Hijau Project, Indonesia	Assessed dewatering requirements and the effects of dewatering, pit lake formation; and waste rock, on groundwater and surface waters. Conducted numerical modelling of groundwater regime to evaluate mine inflows over life of mine.
Diavik Diamond Project NWT	Provided on-going hydrogeological investigations to determine groundwater inflows to a mine located near Yellowknife. Duties included conducted permeability tests in deep exploratory boreholes, design of deep groundwater sampling device, conducting a pumping test in an exploratory decline, and modelling to assess mine inflows, dewatering systems and strategies, and remedial measures. Acted as expert witness during project approval process.
Cominco NWT	Conducted feasibility level investigations to determine hydrogeological regime and to estimate flows to proposed open pit mine. Conducted modelling investigations to estimate inflows to proposed open pit and design preliminary dewatering process.
Newmont Gold Company Mesel Project, Indonesia	Provided recommendations on well installations and testing, to be conducted by the owner to characterise the hydrogeology at a mine site. Conducted numerical modelling to assess mine depressurisation for slope stabilisation.
Cominco Ltd. Smithers, BC	Evaluated the groundwater inflows and groundwater pressures following installation of proposed remedial measures at a closure of an open pit mine. Included numerical modelling to assess proposed closure measures.
Meadowbank Nunavut	Hydrogeological Lead in the Environmental assessment for gold deposit in Nunavut. Included development of Baseline studies, numerical modelling to assess effects of project on groundwater regime and pathways to other receptors.
Royal Oak Mines NWT	Modelling to assess pit lake formation and groundwater flow conditions under long term equilibrium conditions.
Armenonic Ecuador	Assessed the existing tailings pond dam and proposed additions. Included recommendations for monitoring and slope stability improvements.
Teck Corporation Chile	Modelling to predict pit lake formation and long-term groundwater flow conditions.
Cominco Ltd. Pine Point, NWT	Computer modelling of groundwater regime. Assessment of dewatering schedule and procedures. Included training of mine staff in model utilisation.
PetroCanada Ltd. Chetwynd, BC	Modelling of groundwater flow regime at a proposed open pit mine to assess groundwater inflow.
Fording Coal Elkford, BC	Assessed tailings dam leakage and designed leakage retrieval system.
Effects of Open Pit Mine on Groundwater Supply Fife Lake, SK	Evaluated the impacts of an open pit coal mine in Southern Saskatchewan on the quality and quantity of groundwater at a nearby town. Conducted domestic water well survey and collected water samples over two years to assess impacts.

Tar Sands Development Fort McMurray, AB	Assessed the groundwater regime at a proposed tar sands development in Northern Alberta. Included computer model to estimate mine inflow and to develop mine dewatering strategies.
Open Pit Coal Mine Wabamum, AB	Conducted modelling of the groundwater regime at a open pit coal mine, to evaluate the impact of the mine on the regional groundwater system and resource.
Coal Washing Reservoir Gravelbourg, SK	Characterised the groundwater regime beneath a proposed coal washing reservoir. Included computer model analysis to determine the effect of high water levels in lagoon on the regional groundwater flow system and on groundwater supply.
Coal Aquifers Alberta	A study to characterise the hydraulic parameters of coal aquifers in Alberta. Included analyses of hundreds of pumping tests to determine effect of fracturing on transmissivity and storativity of coal seams.

PROJECT EXPERIENCE – HYDROGEOLOGICAL ASPECTS OF UNDERGROUND MINE DEVELOPMENT

Teck Corporation Alaska	Conducted studies to estimate mine inflow and to assess dewatering and grouting strategies at a proposed underground mine. Included packer testing, installation of monitoring wells, water sampling, pumping tests and numerical modelling. Designed wells for the injection of treated mine water during the development of exploration decline. Providing on-going hydrogeological assessment for full mine development.
Giant Mine Northwest Territories	Conducted hydrogeological investigations related to an existing and a recently excavated arsenic stope. Conducted permeability testing and hydraulic head measurements in the pillar between stopes. Recommended the installation of a drainage galley beneath the two stopes to promote dewatering of the stopes. Drainage galley was nearing completion when the mine was shut-down.
Winspear Northwest Territories	Provide hydrogeological services to the EIS and Feasibility mine plan. Investigations have included the installation of piezometers, permeability testing and water sampling. Computer modelling was undertaken to estimate mine inflows during the exploration decline and at the planned full mine development.
Pend Oreille Washington	Hydrogeological investigations related to mine expansion. Investigations included permeability testing and hydraulic head measurement of proposed shaft development. Computer modelling was undertaken to estimate inflows to shaft development. Provide recommendations on mine dewatering strategies and grouting procedures.
Turquoise Ridge Nevada	Hydrogeological investigations to develop dewatering strategies to improve trafficability in production areas. Included 3-D visualization of underground development, geology, structure and measurements of groundwater inflow during drilling of long exploration holes. The structure and geology were correlated to high inflows in order to identify major groundwater pathways that can be intercepted and drained prior to mining.

Asia Pacific Thailand	Conducted pre-feasibility and feasibility hydrogeological investigations of a proposed underground potash mine. Including pumping tests, installation of monitoring wells, water sampling and numerical modelling. Estimated mine inflows and water supply potential and provided conceptual dewatering strategies.
Polaris Mine Cornwallis, NWT	Provided testing procedures to determine hydrogeological properties at a proposed underground mine expansion. Numerical modelling was conducted to assess mine inflow at a planned expansion.
Raglan Northern Quebec	Undertook and groundwater benchmark study that examined potential groundwater issues that could result if underground mining progressed below the permafrost zone. The quantity of inflow to this mine was of a particular concern as the ventilation in the underground is not heated. All previous mining was within the permafrost. Studies included review of thermal regime data, groundwater inflows to boreholes drilled below the permafrost, regional water level elevations of large lakes in area, geology and hydrogeologic projects with similar hydrogeologic and thermal regimes.
Red Mountain Smithers, BC	Conducted hydrogeological investigations to assess hydrogeological conditions and to estimate mine inflows to proposed underground mine.
Westmin Resources Myra Creek, BC	Characterised the groundwater regime and determined the source of acid rock drainage. Investigation included installation of wells, permeability testing and water sampling. Assisted in the design of remedial measures.
Uranium Mine Northern Saskatchewan	Developed a computer model of the groundwater regime at a proposed underground uranium mine. Analyses included assessment of mine inflows to various proposed mine plans and the effect of grouting and/or dewatering on mine inflow and water pressures.
Potash Mine Esterhazy, SK	Model analysis of groundwater regime to determine approximate location and chronology of leaks at an underground potash mine. Included analyses of several hundred drill stem tests to determine formation transmissivities and numerical modelling.
Hudson Bay Mining and Smelting Manitoba	A study to estimate groundwater inflow and recommend dewatering strategies in underground mines at Photo Lake and Kunoto Lake.
Eldorado Gold Corporation Turkey	A study to estimate groundwater inflow to a proposed underground mine and to assess the effects of mining on the groundwater and surface water regime.
Homestake British Columbia	Hydrogeological study including pumping tests, inflow mapping, structural modelling and packer testing. Groundwater inflow was estimated for the life of the mine. Dewatering wells were designed and installed. Dewatering strategies were determined.

Snap Lake Northwest Territories	Provided technical assistance on hydrogeology components of an environmental assessment and in hearings relate to project approvals and permitting. Included characterization of the regional groundwater flow regime and the prediction of the direction, travel time and contaminant transport of dissolved metals originating from the mine following closure of the mine. The environmental assessment was approved in late 2003.
TVX Gold Eastern Europe	Assessment of groundwater inflow to a proposed underground mine. Included the development of a computer model that was calibrated to measured inflows to preliminary mine development.
Diavik Diamond Project Northwest Territories	Providing ongoing hydrogeological investigations to determine groundwater inflows to a mine located near Yellowknife. Duties have included conducting permeability tests in deep exploratory boreholes and conducting pumping tests in the underground mine. Numerical hydrogeological modelling was undertaken to assess mine inflows, dewatering systems, dewatering strategies and remedial measures. Drainage galleries consisting of 4 to 6 drainholes were designed and installed at approximately 75 m depth intervals in the underground mine. Acted as expert witness during project approval process.
Jullietta Former U.S.S.R	Groundwater investigations at a proposed underground mine to assess groundwater inflows. Groundwater model was developed and calibrated to inflows to advanced exploration program.
T'Sable River British Columbia	Groundwater investigations to assess groundwater inflows to an exploration decline. Investigations included flow meter testing, permeability testing, piezometer installation and computer modelling. The potential for saline water intrusion will be assessed.

PROFESSIONAL AFFILIATIONS

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

Member, Association of Professional Engineers, Geologists & Geophysicists of Alberta

Member, Association of Professional Engineers, Geologists & Geophysicists of the Northwest Territories

Member, International Association of Hydrogeologists

PUBLICATIONS

Other

Romano, C., W. Zawadzki, D.W. Chorley, D.M. Mchaina, T. Pallop, and J. Yuke. 2009. Design of open pit dewatering system – Minago Project, Grand Rapids, Manitoba. in Proceedings of 62nd Canadian Geotechnical Conference and 10th Joint CGS/IAH-CNC Groundwater Conference, Halifax, NS.

Chorley, D.W., Pesendorfer, M., Zawadzki, W., Rogers, S., Beddoes, R., Greer, S. 2009. Northwest Wall – Hydrogeological Characterization – Diavik Diamond

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Pesendorfer, Marc, Chorley, Don W., and Greer, Sarah. July 2008. “Flow Recession Test to Characterize Deep Hydrogeologic Regime, Northwest Territories, Canada.” Water in Mining, I International Congress on Water Management in the Mining Industry, Santiago, Chile, Editor. Dr. Jacques Wiertz.

Zawadzki, Willy, Chorley Don W., Chance, Al, Scholte, John and Warnock, George. 2008. “Design of Pit Wall Depressurization System – Highland Valley Copper, Logan Lake, BC.” Proceedings of Joint IAH-GNC Conference, Edmonton, AB.

Bieber, C., Moffitt, K., Chorley, Don W., Zawadzki, Willy, and Greer, S. 2007. “Detailed Evaluation of Pit Slope Stability in Fractured Rock and Kimberlite Slope – Diavik Diamond Mine, NWT.” In Proceedings of 60th Canadian Geotechnical Conference and 8th Joint CGs/IAH Groundwater Conference, Ottawa, ON.

Reinson, J. R., Chorley, Don W., Rogers, S.F., Wozniewicz, J.V., and Zawadzki, Willy. 2007. “Influence of highly permeable geologic structure on inflows to A154 N/S Open Pit, Diavik Diamond Mines Inc., Lac de Gras, NWT.” In Proceedings of USEPA/NGWA Fractured Rock Conference. Portland, Maine.

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Sacré, J., Liston, G.L., Sargent, N., Zawadzki, W., Chorley, Don W., and Levenick, J. 2003. “City of Prince George Groundwater Protection Planning.” In Proceedings of the 56th Canadian Water Resources Association Conference, Vancouver, BC.

Zawadzki, W., Chorley, Don W., and O’Hara, G. 2002. “Design and Verification of DNAPL Hydraulic Containment System Adjacent to the Fraser River Estuary, British Columbia.” In Proceedings of the 55th Canadian Geotechnical and 3rd Joint IAH-CNC and CGS Groundwater Specialty Conferences Ground and Water: Theory to Practice, Niagara Falls, ON.

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Kuchling, K., Chorley, Don W., and Zawadzki, W. 2000. “Hydrogeological Modelling of Mining Operations at the Diavik Diamonds Project.” In Proceedings of the Sixth International Symposium on Environmental Issues and Waste Management in Energy and Mineral Production, University of Calgary, Calgary, AB.

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